CARDEROCK DEPARTMENTS

DEPARTMENT 10 – COMPTROLLER OFFICE

The Comptroller Office is located in Bethesda, MD and Philadelphia, PA. Department 10 is responsible for executing the fiscal responsibilities of the Command by providing overall funds administration for all Department of Defense, non-DOD government agencies; and private party funding and orders received, and the administration and execution of the Command Navy Working Capital accounts.

DEPARTMENT 20 – SHIP SYSTEMS INTEGRATION & DESIGN

The Ship Systems Integration and Design Department, located in Bethesda, MD, Norfolk, VA, and Washington, DC. employs over 300 people in four divisions involved in all aspects of total ship and ship systems design, ship systems engineering, and acquisition for surface ships, submarines, combatant craft/boats, and Marine Corps vehicles.

Department 20's efforts focus on: integrating a total system capability for and implementing new technologies and advanced systems into these platforms; working to implement new and advanced operational capabilities for the US Navy and Marine Corps; and producing mission effective and affordable naval ships, submarines, combatant craft/boats, and Marine Corps vehicles. Department 20 also performs test and evaluation, in-service engineering, and integrated logistics support for combatant craft/boats.

Department 20 supports Navy commands, programs, activities and the fleet in research, design, systems integration, operational assessment, and application of advanced technology, tools, processes, and computations to achieve: mission effective and affordable designs; accurate and interoperable product data; advanced ship, submarine and naval capability concepts; integrated ship systems and technologies; and related ship system and process improvements for surface ships, submarines, combatant craft/boats, and Marine Corps vehicles.

Department 20's roles for acquisition include: senior design team management; design integration; project naval architecture; and technical authority support (ship arrangements, combatant craft, design management, and weights and stability).

DEPARTMENT 30 – OPERATIONS DEPARTMENT

The Operations Department supports the Carderock Division and its technical departments by providing timely and cost efficient business, tactical and strategic services.

DEPARTMENT 40 - CONTRACTING AND ACQUISITION DEPARTMENT

The Contracting and Acquisition Department supports the Carderock Division mission by providing the highest quality acquisition products and services on a timely basis while simultaneously satisfying public policy objectives.

DEPARTMENT 50 – HYDROMECHANICS

The Navy's only technical capability for surface and undersea vehicle hull forms and propulsors is resident in the Carderock Division's Hydromechanics Department. Department 50 supports all naval vehicles-surface ships, submarines, unmanned vehicles and craft-by developing the technologies and procedures for systems which define the external shape of the vehicle, control systems and surfaces, and propulsor interaction with the hull and its environment. These systems are necessary to ensure that the performance of each navy vessel meets mission requirements.

DEPARTMENT 60 – SURVIVABILITY, STRUCTURES & MATERIALS

The Carderock Division's Survivability, Structures and Materials Department is the recognized leader in full-spectrum science and engineering of materials and structures, environmental compliance, and survivability of naval ships and submarines. Department 60's people apply their knowledge to research, development, test, evaluation, acquisition and fleet support problems facing the U.S. Navy. Along with industrial, academic, and DoD partners, Department 60 provides the U.S. Navy with the technical depth and specialized knowledge necessary to maintain the technical edge for the world's leading naval fleet.

DEPARTMENT 70 – SIGNATURES

Stealth is the ability of a ship, submarine, water craft, or unmanned vehicle to operate undetected. The Carderock Division's Signatures Department is the world leader in developing superior stealth technologies through signature control and silencing, greatly reducing the vulnerability of Navy vessels to mines, torpedoes, and other dangers. The Signatures Department is engaged in developing basic technology, engineering solutions and supporting acquisitions of signature technology for all classes of ships. Beyond that, the department supports the Fleet's signatures throughout the ships' lives. Department 70's scientists and engineers make measurements of our ships in order to maximize their effectiveness in locations in the United States and overseas. In addition, department employees travel throughout the world to support our ships. The department develops a wide variety of measurement systems, on-board systems, and signature training for our ships and submarines.

DEPARTMENT 90 – MACHINERY RESEARCH & ENGINEERING

The Carderock Division's Machinery Research and Engineering Department, located in Philadelphia PA, provides the facilities and expertise for developing concepts, technologies, equipment, systems and procedures necessary to enable current Navy ships to operate reliably,

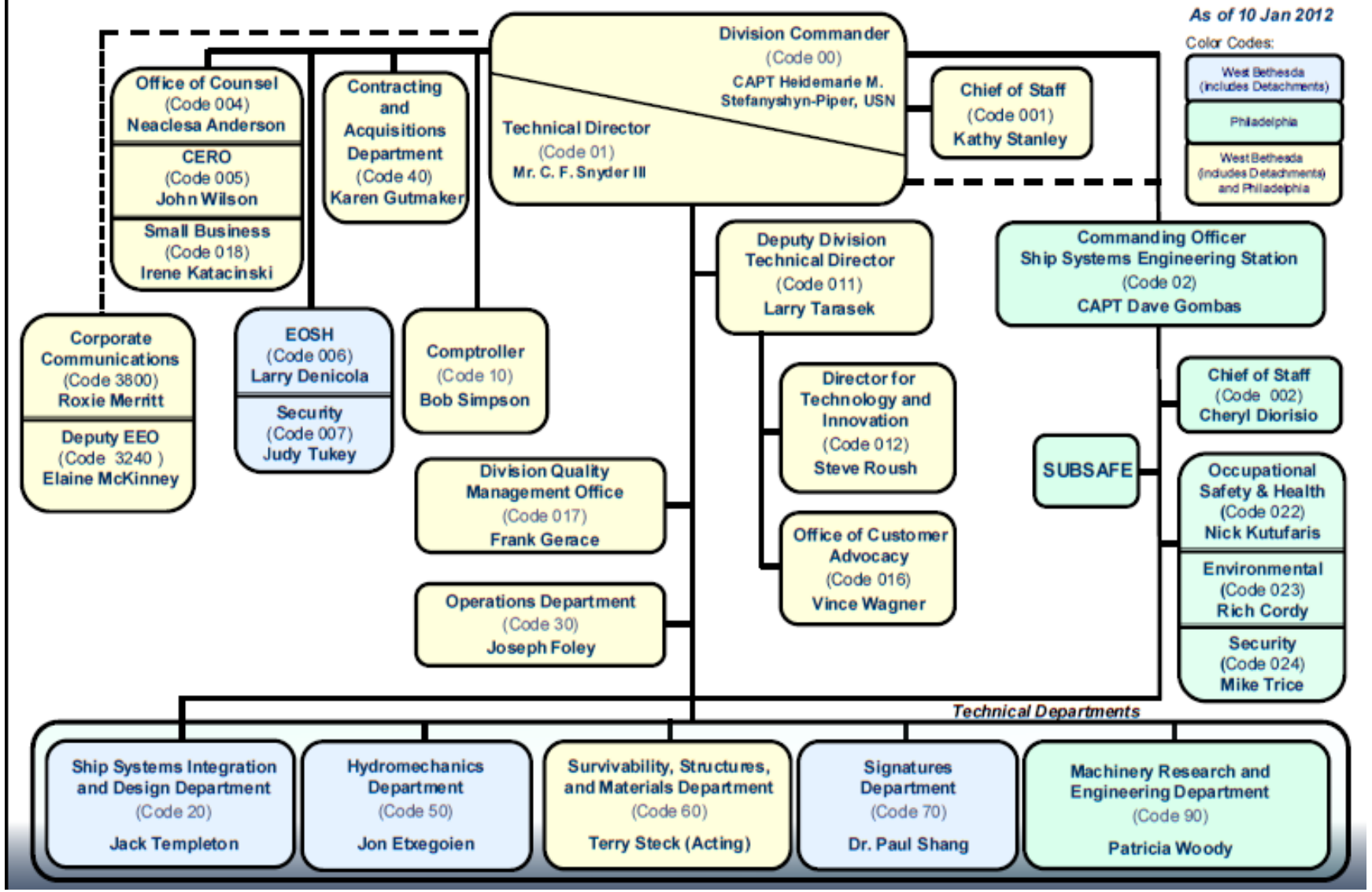
affordably, and effectively to meet performance and mission requirements. Department 90's knowledge of machinery engineering commences at the earliest stages of shipboard equipment and component product development; continues through new ship construction; and supports In-Service engineering for ships and ship systems currently in the Fleet.

In support of future all-electric Navy ships, Department 90 is an active hands-on participant in the community of world-class scientists and engineers who are developing the technology and hardware needed to integrate electric propulsion systems and all-electric ship concept for further surface ships and submarines. Fundamental scientific investigations and engineering research are being conducted in many areas including medium voltage power distribution, power generation, pulse power, energy storage, thermal management, and advanced automation and controls.

Naval Surface Warfare Center

Carderock Division Organization

NAVSEA WARFARE CENTERS Carderock



DEPARTMENT 10 – COMPTROLLER OFFICE

Department Overview:
The Comptroller Office is located in Bethesda, MD and Philadelphia, PA. Department 10 is responsible for executing the fiscal responsibilities of the Command by providing overall funds administration for all Department of Defense, non-DOD government agencies; and private party funding and orders received, and the administration and execution of the Command Navy Working Capital accounts.

Robert S. Simpson
Comptroller Office (Code 10) Department Head

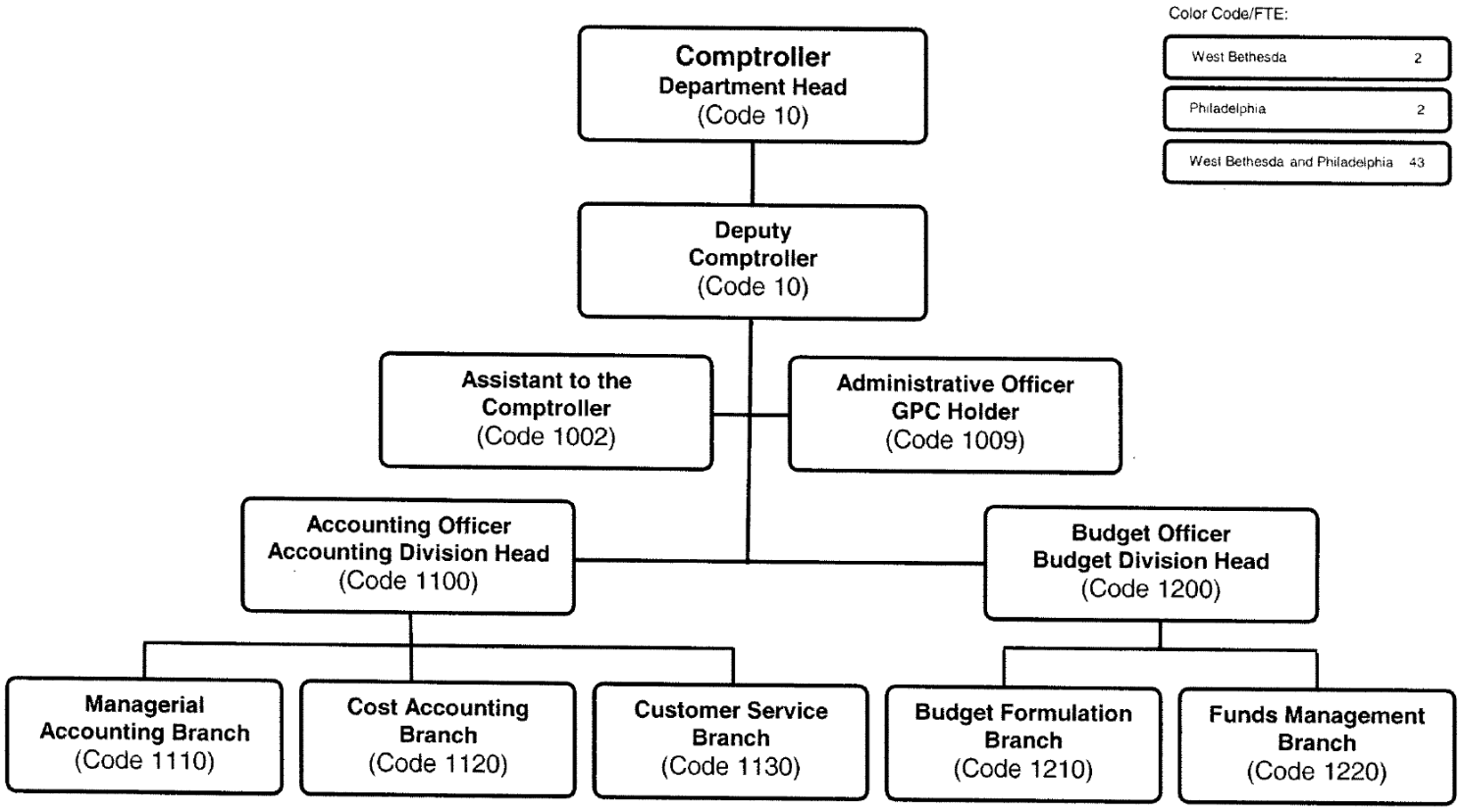
In January, 2011, Robert S. Simpson was selected as the Carderock Division Comptroller. Mr. Simpson joined the Carderock team in October, 2010 as Carderock Division Deputy Comptroller. Mr. Simpson brings years of Navy Working Capital Fund experience to the position, having begun his career in 1998 as an intern in the Financial Management Career Program, moving into the Defense Finance and Accounting Service (DFAS) community and then working at SPAWAR Systems Center Atlantic.

Before coming to Carderock, Mr. Simpson started his career as an accountant at the Naval Air Warfare Center-Aircraft Division in Patuxent River, MD. He transitioned to the Technology Service Organization Patuxent River (TSOPR) as an analyst working on the Defense Industrial Financial Management System (DIFMS). During his time at TSOPR Mr. Simpson led several conversions of legacy accounting systems to the DIFMS. In July, 2004 Mr. Simpson moved to SPAWAR Systems Center Charleston where he served as the Senior Systems Accountant on the DIFMS prior to SSC Atlantic transitioning to Navy ERP in October 2009. Mr. Simpson was the Data Conversion and Finance Module Lead for Navy ERP conversion at SPAWAR Systems Atlantic.

Mr. Simpson holds a Bachelor of Business Administration degree in Accounting from Bellevue University and a Masters degree in Organizational Management from the George Washington University. He is a member of the American Society of Military Comptrollers, the Association of Government Accountants, a Certified Defense Financial Manager with Acquisition subspecialty and a Lean Six Sigma Black Belt. He is retired from the U.S. Navy.

NAVSEA
WARFARE CENTERS
Carderock Division

Comptroller Department (Code 10)



Code 11: Accounting Officer/Accounting Division:
The division is responsible for providing fiscal oversight, accounting and related financial operations; including managerial, cost, and general accounting services, and implementing statutory, regulatory, and procedural accounting policy.

Code 12: Budget Officer:
The division is responsible for providing budgetary oversight, advice, interpretation, dissemination, implementation, guidance, and processes to ensure compliance with policies and guidance issued by higher authority.

DEPARTMENT 20 - Ship Systems Integration and Design

Department Overview:

The Department 20 Ship Design and Integration Technology efforts at Carderock focus on integrating multidisciplinary technologies and systems into total ship designs and support analyses for surface ships, submarines, combatant craft, and Marine Corps vehicles. The effort provides a total system capability, technical depth and breadth, operational understanding, and a vision for producing effective and affordable naval and maritime ships and vehicles. Our mission is systems engineering - the building block of the future Navy. Our formal mission is to provide Division-wide leadership in total ship systems engineering and integration, and in the assessment of technologies for the development of naval ships and marine vehicles. Our Vision is to provide Warfare Center-wide leadership and be the provider-of-choice throughout DoD and the Maritime community in total ship systems engineering and in the integration of technologies for the development of marine systems.

Jack Templeton
Ship Systems Integration and Design (Code 20) Department Head

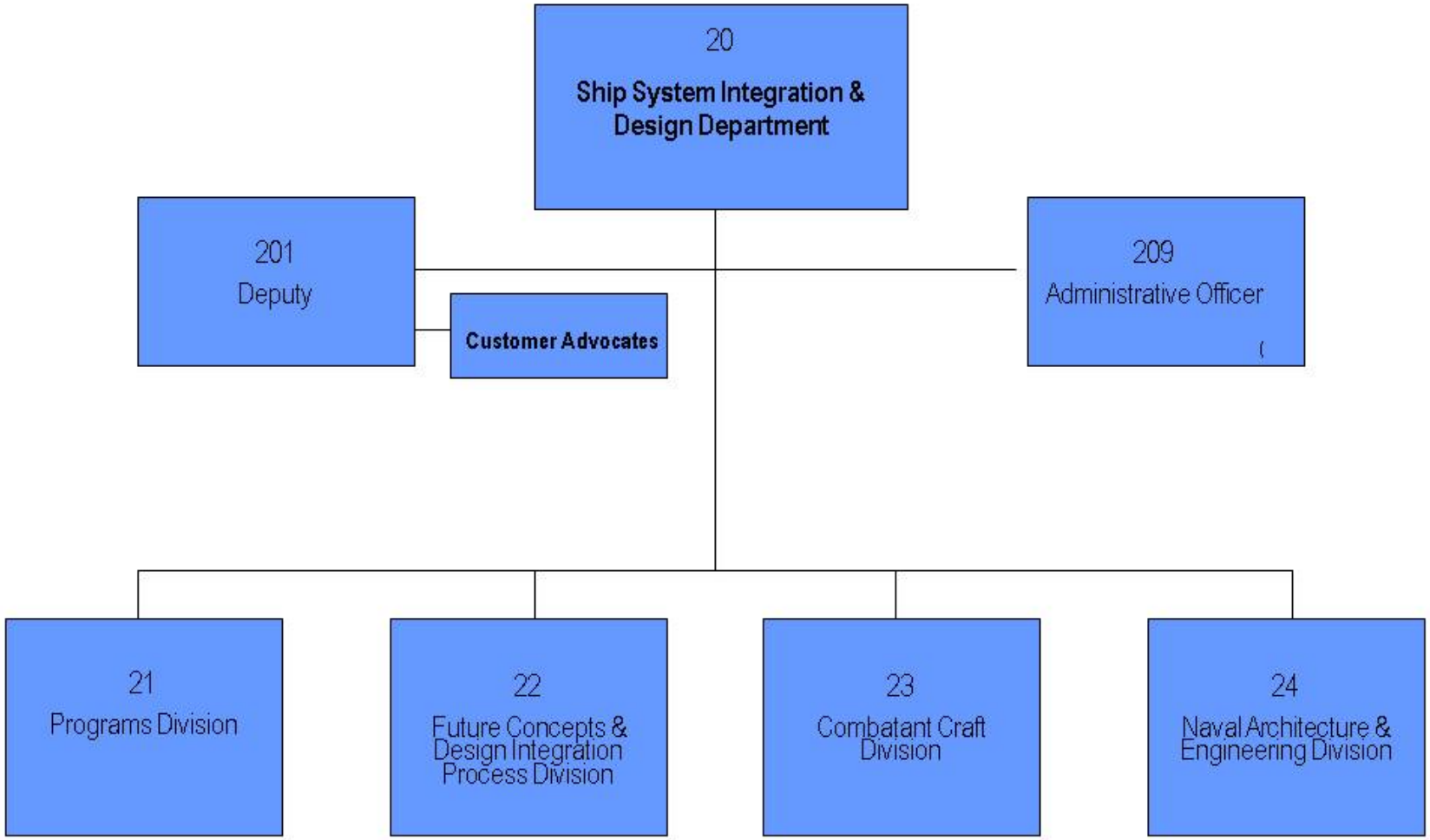
Mr. Templeton is the head of the Ship Systems Integration and Design Department at the Naval Surface Warfare Center's Carderock Division. He also serves as the Core Equity Lead for Ship Integration and Design within the Product Area of Ships and Ship Systems.

Jack was born in Washington D.C. and raised in Montgomery County, MD. He graduated from the University of Maryland, College Park with a Bachelor of Science degree in Civil Engineering. Upon graduation, Jack joined the engineering directorate at NAVSEA as an Engineer-in-Training (EIT) in May of 1982.

Mr. Templeton's EIT assignments pointed him to an interest in ship arrangements, and he was selected by the NAVSEA Ship Arrangements Division to join their ranks in 1983. After joining SEA 55W1, Jack was assigned as a junior arrangements task leader to support the DDG51 (ARLEIGH BURKE) contract design team. Upon contract award, Jack transitioned into the in-service engineering element of SEA 55W1 leading overhaul planning of the Terrier-missile Cruisers (LEAHY and BELKNAP-classes). He then filled an arrangements leadership role in the Battleship/Heavy Cruiser Program, personally leading the refurbishment and fleet re-introduction of the USS WISCONSIN (BB-64) and supported the overhaul planning of the USS DES MOINES (CA-134) class of cruisers.

In 1987, Jack was selected to serve as Branch Head, Surface Combatants Branch SEA 55W14. Over the next several years, Jack's branch expanded to include submarines and aircraft carriers and expanded its technical role to include shipboard habitability. In January 1999, Jack transferred to Code 20 of the Carderock Division as part of the ongoing NAVSEA Enterprise engineering realignment heading up the Naval Architecture Division (Code 2400). He filled that role until October 2009 when he was selected to head up Code 20.

Ship Systems Integration and Design Department



As of 24 February 2012

CODE 21- PROGRAMS DIVISION

Division Overview:

Manages division-wide ship programs and provides total ship systems engineering.

Capabilities and Enterprise:

- Cost/Benefit Type Assessments
- Tools for Military Effectiveness and Costing
- Liaison with Intelligence Community (STILO/SSO)
- Early Stage Technology Assessments
- Industry Design Team War fighting Effectiveness Tradeoffs
- MechRel- Reliability Prediction Procedures for Mechanical Equipment
- Determine the reliability of a new design in its intended operating environment while that design is still on the drawing board
- Perform Failure Mode, Effects and Criticality Analyses (FMECA), determining occurrence probabilities of equipment failure modes such as wear and fatigue
- Visualize reliability requirements in the early development phase and establish an optimum maintenance philosophy for the equipment

CODE 22 - FUTURE CONCEPTS & DESIGN INTEGRATION PROCESS DIVISION

Division Overview:

The Future Concepts & Design Integration Process Division applies advanced information technology to assist Navy technical data and process owners. The mission is to support Headquarter Commands, Programs, Fleet, naval activities, and Ship Systems Integration and Design Department in research, design, assessment, and application of advanced technology, tools, processes, and computations to achieve effective and affordable ship designs, accurate and interoperable product data, modular and interoperable ships systems and interfaces, and related ship system and process improvements.

Capabilities and Enterprise:

- Develop Future Ship Designers
- Knowledge Base / Design Tools & Processes
- Develop Innovative Ship Concepts
- Future Ship & Ship Design Technology Needs
- Product Data Acquisition and Integration Methods
- Sailor Performance Support Technology

- Processes, tools, and technologies for the acquisition, creation, management, and use of Navy Ship and Ship Systems Product Data.
- Data Standards & Technology for Digital Product/Technical Data
- DoN Policy & Guidance for Digital Product/Technical Data (XML, SGML, HTML, CGM, Raster & Vector Formats)
- Electronic Technical Manuals/Interactive Electronic Technical Manuals (ETM/IETM) Technology
- Requirements definition, concept formulation, design, development, and specification of electronic sailor performance support systems.
- Technologies and processes for the application of performance enhancing devices and the delivery/presentation of electronic ship engineering, product, and technical data.
- Conceptual Development Capability
- Design Analysis Capability
- Design Integration Capability

CODE 23 - COMBATANT CRAFT DIVISION

Division Overview:

The Combatant Craft Division provides superior quality, total systems engineering support for all types of manned and unmanned combatant craft, boats, and advanced marine vehicles. This includes full spectrum and full life cycle engineering, research and development, concept feasibility, design, test and evaluation, and integrated logistics support. Combatant Craft Division (CCD) supports the U.S. Navy, Army, Marine Corps, Naval Special Warfare, Air Force, Coast Guard and other DoD and non-DoD activities including private industry.CCD leverages boat and craft lessons learned across the DoD community and works collaboratively to transfer technology and combine resources to reduce redundancy and improve efficiency.

Capabilities and Enterprise:

- Maximize Warfigher Performance, Minimize Total Ownership Cost, Manage Risk
- Anchored in principles, CCD is the authoritative and preferred source of Full Spectrum and Full Life Cycle Engineering for Combatant Craft, Boats and Watercraft throughout the Department of Defense and the Maritime Community.
- Specialized Waterfront Test and Evaluation Sites
- Extensive Test Instrument Lab
- Technical Data Repository
- Test Boat Fleet
- Convenient Access to Boat Yards
- Secure Work Areas

CODE 24 - NAVAL ARCHITECTURE AND ENGINEERING DIVISION

Division Overview:

The Naval Architecture Division (Code 24) provides quality naval architectural and ship design services to Navy and non-Navy customers. Primarily naval architects and engineers in related technical fields, the Department's 60-person staff develops and maintains ship design tools; researches, develops, and assesses ship concepts and related technologies; and supplies ship design products. Specialty areas include weight and stability, ship arrangements, human systems integration, RMA, habitability and systems safety. Products and services are nominally for surface ships greater than 30m/100 ft in length (i.e., other than combatant craft and boats) and submarines.

Capabilities and Enterprise:

- Total ship feasibility studies
- Ship impact assessments of new or evolving subsystems technologies
- Ship arrangement studies
- Weight estimates, stability assessments, and related studies
- Hull form deign studies and hydrodynamic performance analyses
- Stability assessments
- Human systems integration studies and analyses
- Technical and project management service
- Reliability, maintainability, and availability (RM&A) analyses
- Ship design tools and models
- Concurrent Engineering
- SMART SHIP
- CVX
- SC 21
- LPD 17
- CG 47
- CVN Carriers
- Military Sealift Command

Code 30 - Operations Department

Department Overview:
The Operations Department supports the Carderock Division and its technical departments by providing timely and cost efficient business, tactical and strategic services. Our mission is to provide efficient and effective business solutions to facilitate and enable the Naval Surface Warfare Center, Carderock Division in achieving its strategic direction and technical mission while maintaining the public trust at the lowest cost. Our vision is to achieve a diverse, highly motivated workforce that delivers on-time, quality business solutions and service excellence to our customers through partnering and continuous process improvement.

Joseph Foley

Operations Department (Code 30) Department Head

In September 2010, Joseph Foley was selected as the Operations Department Head, Code 30. He joined the Carderock Team in July 2008 as the Acquisition Division Head, Code 33, in Philadelphia, Pa.

Mr. Foley began his federal career at the Naval Inventory Control Point (NAVICP) in the early 1980s, mostly supporting aviation acquisition. Over the years, he ran the helicopter contracting division and the F/A-18 contracting section. During his career at ICP, he held several positions, including a term as Head of Marketing and New Business Development, an assignment resulting from his involvement in NAVSUP's Corporate Management Development Program. During this three-year assignment, he marketed the Navy's logistics supply support function to ship and aviation contractors to ensure the continuation of in-house expertise and integrity of the supply system. In 2005, he took a position at Naval Air Warfare Center Aircraft Division (NAVAIR), Lakehurst, N.J., where he worked on special programs, missions, and communications, as well as supporting contracts for older, aging aircraft support equipment.

Mr. Foley holds a bachelor's degree in business from Rutgers University and is certified in purchasing management through Penn State University. He is DAWIA Level 3 certified and is a member of the Acquisition Professional Community. He was also a member of the National Association of Purchasing Managers and was active in the Philadelphia chapter as a leader of the trade show committee.

The new department head has been the Chief of Contracts at Carderock Division for the last two years. During this time contract obligations increased from $691M in FY08 to $849M in FY10.

He was awarded the Meritorious Civilian Service Award for his marketing efforts and NAVICP; the Bronze Medal for Excellence in Government Awards-Supervisory Rookie of the Year; the

Bronze Medal for Excellence in Government Award-Economy in Government Operations; many special act awards, certificates of appreciation, as well as numerous awards for outstanding and superior performance. He is very employee- and customer-oriented.

Mr. Foley will be working out of our SSES office, and will be traveling to our West Bethesda campus on a regular basis.

Code 32 - Human Resources Division

The Human Resources Division is responsible for the overall management of the Human Resources Division (HRD) following legal and regulatory requirements. The division head serves as the principal official for all Carderock Division corporate human resource management issues, and as the principal internal advisor on all equal employment opportunity (EEO) matters.

Code 34 – Corporate Information Services Division

The Corporate Information Services Division (CISD) is responsible for providing Corporate Information Technology (IT) solutions and services to the Carderock Division. The CISD provides the Division with IT strategic vision, leadership, technical expertise, and enterprise solutions.

Code 36 – Facilities and Model Fabrication Division

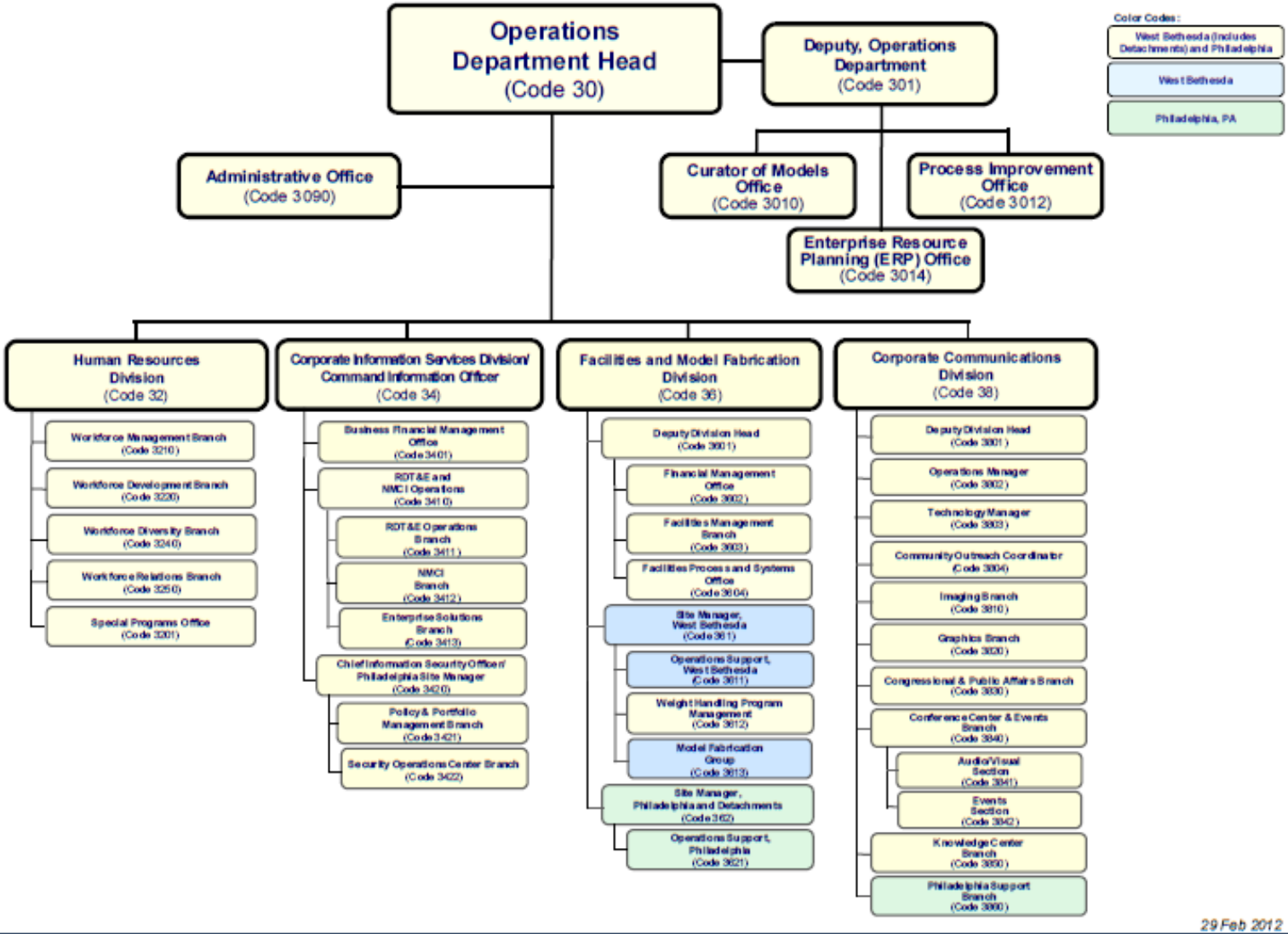
The Facilities and Model Fabrication Division is responsible for managing and supporting the Carderock Division's facilities assets, maintaining model fabrication/specialized manufacturing capability, and providing industrial support to technical codes.

Code 38 – Corporate Communications Division

The Corporate Communications Division is responsible for the Naval Surface Warfare Center, Carderock Division's (NSWCCD) processes and products related to internal and external communications and information services other than those services associated with Information Technology. The Corporate Communications Division is the staff agency responsible for planning and executing integrated and synchronized communications support for NSWCCD, Naval Ship Systems Engineering Station (NAVSSES), and all subordinate sites. The Corporate Communications Division focuses on the information functions that create, deliver, store, and maintain information content related to NSWCCD. The Corporate Communications Division also performs and manages direct work as requested by technical customer.

NAVSEA
WARFARE CENTERS
Carderock Division

Operations Department (Code 30)



DEPARTMENT 40 – CONTRACTING & ACQUISITION

Department Overview:
The Contracting and Acquisition Department supports the Carderock Division by providing the highest quality acquisition products and services on a timely basis while simultaneously satisfying public policy objectives.

Karen B. Gutmaker
Contracting and Acquisition (CODE 40) Department Head

Ms. Gutmaker has earned a Masters degree in Management and brings with her over 27 years of specialized experience in the contracts arena. She joined the Carderock Division in 2001 and served at the Head of the SeaPort-e office during implementation.

Ms. Gutmaker has been the Philadelphia Acquisition Branch Head since 2007. As the Philadelphia Branch Head, Ms. Gutmaker has demonstrated her dedication to customer service and timely processing of acquisition actions.

In addition to her experience at the Carderock Division, she also served in contracting positions at the Oklahoma City Air Logistics Center and the Defense Commissary Agency.

Code 41 – R & D Acquisition Division

The Research & Development Acquisitions Division (Code 41 (West Bethesda (WB)) is responsible for the procurement of services, hardware, equipment, and materials, in support of the Carderock Division and the Fleet through a variety of authorized acquisition procedures, including Large Purchase, Simplified Acquisition Procedures, Government Purchase Card, and SeaPort. Functions as the West Bethesda Site Lead..

Code 42 – Hull, Mechanical and Electrical Acquisition Division

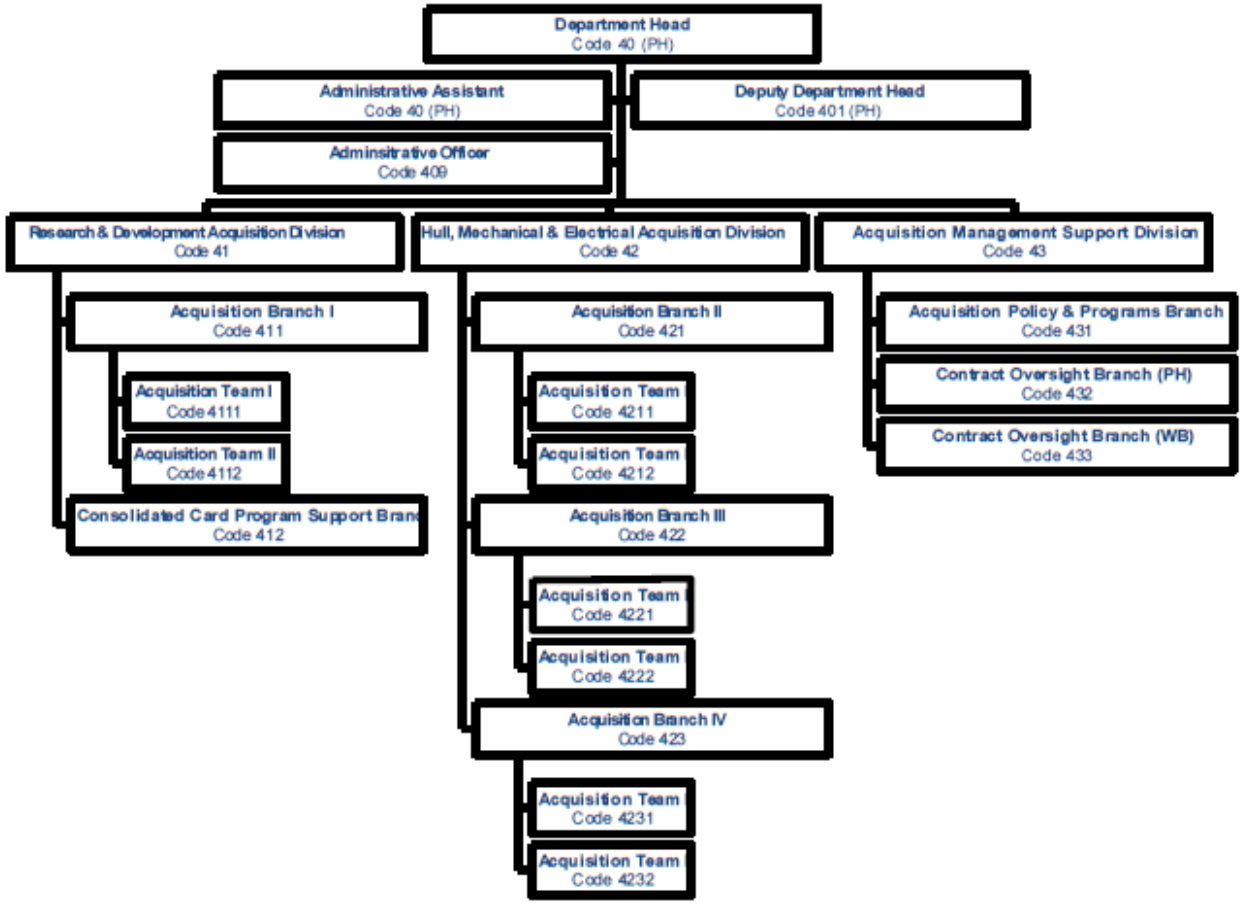
The Hull, Mechanical & Electrical Acquisition Division (Code 42 (Philadelphia (P)) is responsible for the procurement of services, hardware, equipment, and materials, in support of the Carderock Division and the Fleet through a variety of authorized acquisition procedures, including Large Purchase, Simplified Acquisition Procedures, and SeaPort. Functions as the Philadelphia Site Lead.

Code 43 – Acquisition Management Support Division

The Acquisition Management Support Division (Code 43 (P)) supports the Acquisition Divisions serving as the central point of advice, expertise and assistance on acquisition management, data, procurement systems, contract oversight and acquisition policy related matters.

NAVSEA
WARFARE CENTERS
Carderock Division

Contracting and Acquisitions Department
Code 40



DEPARTMENT 50 - HYDROMECHANICS

Department Overview:

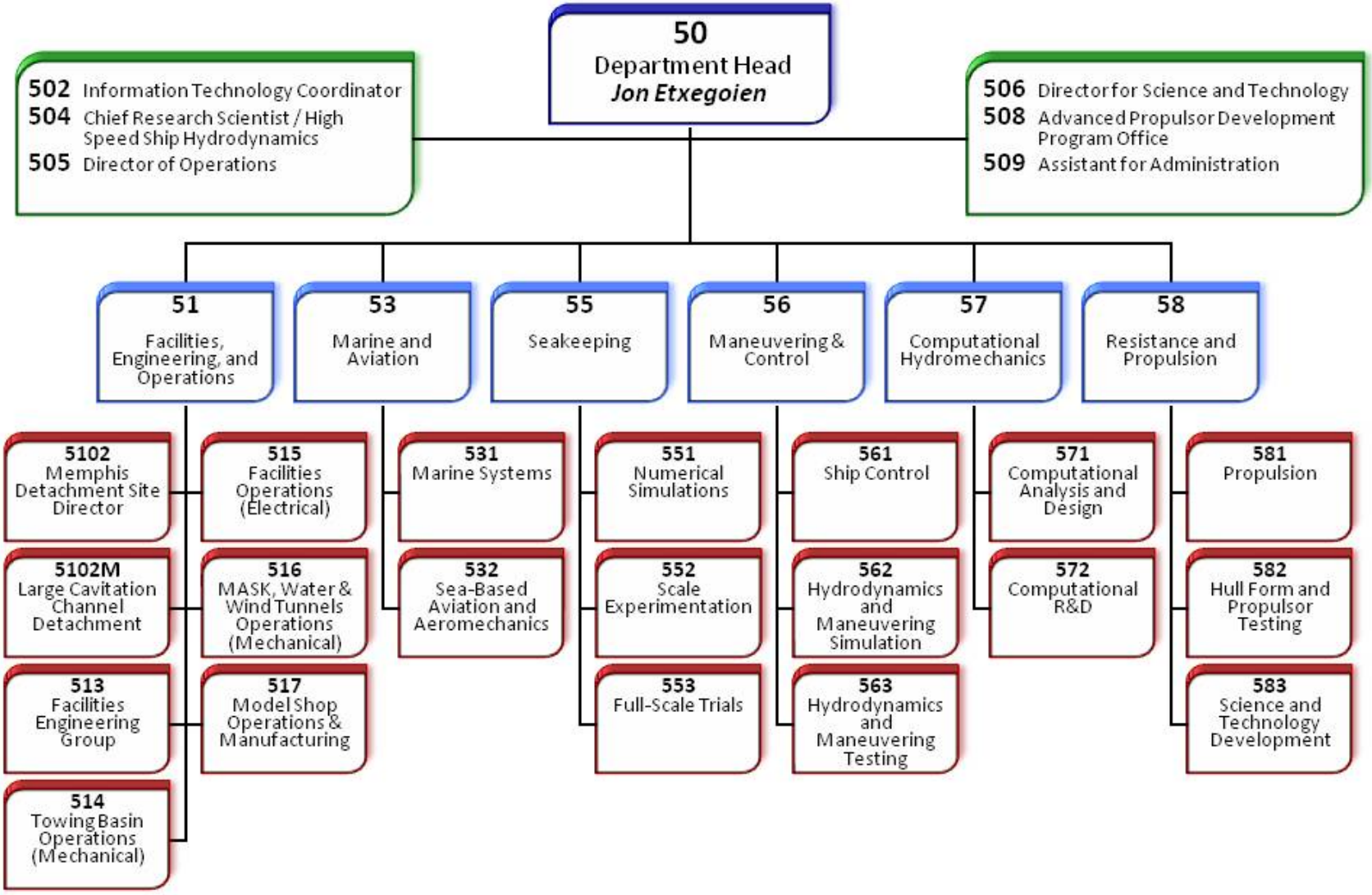
The Hydromechanics Department (Code 50) researches hull forms, propulsion, and ship dynamics to provide the foundation for new ship and submarine designs. Department personnel use a variety of computational tools, large models, towing tanks, water tunnels, and seakeeping basins to evaluate concepts for new ship and submarine designs.

Jon F. Etxegoien
Hydromechanics (Code 50) Department Head

Mr. Jon F. Etxegoien graduated from Florida Institute of Technology in 1980 with a degree in Ocean Engineering and spent the following year in the Oceaneering Commercial Diving school in California learning Hard Hat Diving and Bell/Saturation diving techniques. Upon completion of that training he returned to the East Coast and took a job with the Towed Systems Branch here at the Naval Surface Warfare Center Carderock Division. Mr. Etxegoien spent 19 years with the Towed Systems Branch working on all manner of towed vehicles, towed and bottom mounted arrays, towing of salvaged vessels and a in a variety of Ocean Engineering projects that allowed him to work with many other Warfare Centers, other Navy organizations and many private concerns.

In 1999, Mr. Etxegoien took an Assistant Program Manager position with the Program Executive Office for Littoral and Mine Warfare at the Navy Yard and spent the next 4 years leading the AQS-20A Minehunting Sonar program. While in PEO LMW, Mr. Etxegoien was one of the NAVSEA employees selected to attend the Naval Post Graduate School's Product Development/System Engineering Masters program which he completed in 2002.

In 2004, Mr. Etxegoien returned to Carderock Division as Director of Operations for the Hydromechanics Department, a staff position that dealt with many of the Department's business functions. In 2009, he was selected as the Department Head for Hydromechanics. The Hydromechanics Department is the oldest Department here in West Bethesda, having come here from the Washington Navy Yard shortly after World War II when the towing tanks were completed and can trace its roots back to Admiral David W. Taylor and the first Navy towing tank which opened at the Navy Yard in 1899.


50
Department Head
Jon Etxegoien
502 Information Technology Coordinator
504 Chief Research Scientist / High Speed Ship Hydrodynamics
505 Director of Operations
506 Director for Science and Technology
508 Advanced Propulsor Development Program Office
509 Assistant for Administration
51
Facilities, Engineering, and Operations
53
Marine and Aviation
55
Seakeeping
56
Maneuvering & Control
57
Computational Hydromechanics
58
Resistance and Propulsion
5102 Memphis Detachment Site Director
5102M Large Cavitation Channel Detachment
513 Facilities Engineering Group
514 Towing Basin Operations (Mechanical)
515 Facilities Operations (Electrical)
516 MASK, Water & Wind Tunnels Operations (Mechanical)
517 Model Shop Operations & Manufacturing
531 Marine Systems
532 Sea-Based Aviation and Aeromechanics
551 Numerical Simulations
552 Scale Experimentation
553 Full-Scale Trials
561 Ship Control
562 Hydrodynamics and Maneuvering Simulation
563 Hydrodynamics and Maneuvering Testing
571 Computational Analysis and Design
572 Computational R&D
581 Propulsion
582 Hull Form and Propulsor Testing
583 Science and Technology Development

CODE 51 - FACILITY ENGINEERING & OPERATIONS DIVISION

Division Overview:

The Facility Engineering & Operations Division is responsible for ensuring the safe and effective technical administrative direction of all of Code 50's test facilities. These facilities include the Large Cavitation Channel Detachment, Towing Basin, MASK, Water, and Wind Tunnel, and Model Shop.

Capabilities and Expertise:

- Maintenance, operation, and effective utilization of Department test facilities and other resources
- Planning, designing, and implementing upgrades to test facilities.
- Planning and managing capital improvements.
- Planning, design, and producing wood and composite water craft models.

CODE 53 - MARINE & AVIATION DIVISION

Division Overview:

The Marine & Aviation division is responsible for the design, development, and evaluation of naval and aviation systems. The group performs feasibility, engineering assessments, design trade-off studies and concepts for innovative solutions and development of future systems.

Capabilities and Expertise:

- Towed /Tethered systems and platforms; moored devices and platforms; special hydrodynamic systems and subsystems including underwater unmanned vehicles, non-lethal ship stopping systems, and environmental and oil spill systems
- Analytical and experimental evaluations of aeromechanical design. Simulations of air and sea platforms and weapons systems.
- Wind tunnel and towing basin model experiments for specific aerodynamic and hydrodynamic evaluations and performance predictions of systems in a working environment.
- Dynamic interaction of towed, tethered moored systems with surface ship and other dynamic platforms, cable handling systems, unmanned air and underwater vehicles, and the ocean environment, including surface waves and currents.

CODE 55 - SEAKEEPING DIVISION

Division Overview:

The Seakeeping division conducts fundamental and applied research, development, and evaluation of the dynamic behavior of surface ships, small craft, floating platforms, and high performance vehicles. This research is performed through model and full-scale seakeeping and maneuvering trials, many of which are conducted jointly on multi-disciplinary projects with other departments.

Capabilities and Expertise:

- Application of experimental, analytical, computational, and simulation techniques to study seakpeeing, dynamic stability, smooth and rough water maneuvering qualities.
- Integration of vehicles with control systems, design evaluation, operational assessment, and operator guidance.
- Developing technology for measuring, predicting, and improving seakeeping and maneuvering qualities, and applying this and related technology to evaluating specific ship designs. Identifying design faults and providing assistance in correcting and improving ship designs.
- Defining, measuring, and archiving sea environmental data as it applies to the seakeeping design and performance operability of ships.

CODE 56 - MANEUVERING & CONTROL DIVISION

Division Overview:

The Maneuvering & Control Division executes duties as NAVSEA Engineering Agent for Submarine Hydrodynamics and Submarine ship control.

Capabilities and Expertise:

- Computer simulations of submarines and other marine vehicle dynamics including environmental effects (such as seaway and temperature gradients, control system characteristics, variable mass systems, propulsion machinery, and missile launch forces and moments).
- Development of submerged operating envelopes and other operational guidance; evaluate full-scale incidents; predict full-scale performance; perform man-in-the-loop and hardware-in-the-loop studies; support automatic control system algorithm development; support ship control system design and evaluation; and trouble-shoot ship control performance problems reported by the fleet.
- Development and maintenance of captive models. Operating models to identify stability and control characteristics via the measurement of forces and moments on the full, appendages, and propulsors.

CODE 57 - COMPUTATIONAL HYDROMECHANICS DIVISION

Division Overview:

The Computational Hydromechanics Division maintains the Navy's capability to develop and apply high-end theoretical and computational fluid dynamics techniques for the solution of the governing equations describing the physics of real fluid flow around submarines, surface ships, and propulsors.

Capabilities and Expertise:

- Evaluation and analysis of new ship, submarine, and propulsor design.
- Shape optimization for novel concepts such as high speed sea lift and non-body of revolution submarine concepts.
- Applied research and techniques related to, but not limited to, the solution of the Navier-Stokes equations using Reynolds Averaged, Large Eddy Simulation, Detached Eddy Simulation, and Direct Numerical Simulations.
- Theoretical and computational methods for linear and non-linear analysis of free surface flows past bodies moving in or near a free surface, in deep or shallow water.

CODE 58 - RESISTANCE & PROPULSION DIVISION

Division Overview:

The Resistance & Propulsion Division conducts research, development, characterization, and evaluation of resistance and powering of ships, submarines, advanced craft, and other vehicles of interest to the Navy, and industry.

Capabilities and Expertise:

- Research of boundary layers, vortex flows, ship-resistance theory, friction drag, drag reduction, separation effects,
- Predicting the resistance and powering performance of full-scale ships, submarines, advanced craft, and other vehicles.
- Integrating and applying existing numerical tools in the form of algorithms, computer codes, interactive graphic systems, and grid generation techniques to the solution of governing equations describing the physics of real fluid flow around submarines, surface ships, and areas around operating propulsors.
- Developing appropriate instrumentation for model and full-scale evaluation experiments for resistance, propulsion, turbomachinery, and fluid systems.

DEPARTMENT 60: Survivability, Structures and Materials

Department Overview:

The Carderock Division's Survivability, Structures and Materials Department is the recognized leader in full-spectrum science and engineering of materials and structures, environmental compliance, and survivability of naval ships and submarines. Department 60's people apply their knowledge to research, development, test, evaluation, acquisition and fleet support problems facing the U.S. Navy. Along with industrial, academic, and DoD partners, Department 60 provides the U.S. Navy with the technical depth and specialized knowledge necessary to maintain the technical edge for the world's leading naval fleet.

Michael S. Brown
Survivability, Structures and Materials (Code 60) Department Head

Mr. Michael S. Brown graduated from the University of Utah in Mechanical Engineering in 1985 and started his career at NSWC Carderock Division with the Submarine Structures Division, Composite Materials Branch. He led the mechanical design effort of an Advanced Concept Sail Design in the Carderock Innovation Center.

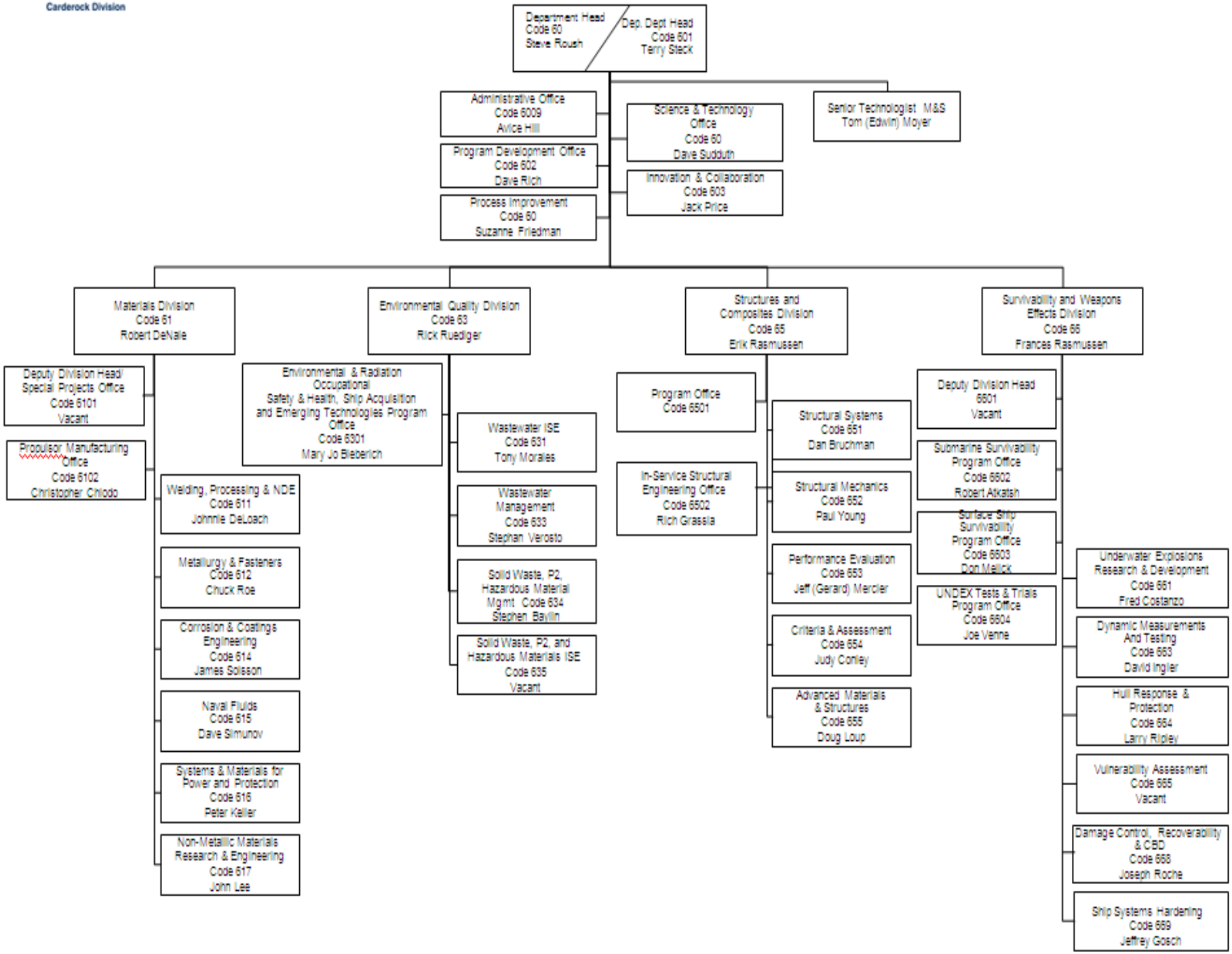
Mike joined the VIRGINIA Class Program in 1993 as the Sail Major Area Team Leader and worked in a variety of positions before becoming the Ship Design Manager in 2000. He managed over 30 Major Area and System Integration Teams and provided the government approval and technical authority for design and R&D products being developed by Electric Boat and the government labs. In 2002, he was selected to lead the SSGN Program to convert four (4) OHIO Class Ballistic Missile submarines into a littoral Special Operations Forces and Cruise Missile platform. In 2004, he was named the SSGN Technical Director to oversee all of design, logistics and test and evaluation for the program.

In 2007, Mike was tasked to start a new office in New London Connecticut and become the Common Missile Compartment Program Manger representative on-site at the Led Design Yard in support of both the U.S. and UK governments. He managed a staff comprised of UK Ministry of Defense, UK private industry, Strategic Systems Program Personnel and Electric Boat in a collaborative international effort.

Recently Mike has been working as the Design for Affordability Manager for the OHIO Replacement Program. He has lead an effort to reduce the overall design, constructions and Operations and Support costs at Electric Boat and PMS397 for the OHIO Replacement Submarine.

NAVSEA
WARFARE CENTERS
Carderock Division

Survivability, Structures, and Materials Department



CODE 61 - MATERIALS DIVISION

Division Overview:

The Materials Division develops high performance, affordable materials for use in ship and ship systems. This work spans a broad spectrum from basic research to shipboard application of metallic and nonmetallic materials, associated processes and their applications to Naval requirements.

Capabilities and Expertise:

- Development of naval alloys (ferrous, non-ferrous and welding consumables)
- Development of polymer and metal matrix composites and processing
- Arc welding and non-destructive evaluation
- Fatigue and fracture assessment, failure analysis
- Marine corrosion (aqueous and marine gas turbines), coatings and corrosion control
- Signature control materials
- Fire safe materials (focused organic composites)
- Ceramic and magnetic materials
- Electrochemical and alternative power sources RDT&E

CODE 63 - ENVIRONMENTAL QUALITY

Division Overview:

The Environmental Quality Division develops and implements onboard and pier side pollution prevention, waste management and safety processes and systems, including radiation detection technologies and personal dosimetry. Efforts include concept development, research, development, testing and evaluation, equipment selection, acquisition, logistics support, maintenance, repair and disposal.

Capabilities and Expertise:

- Pollution prevention, solid and liquid waste management and treatment, hazardous waste management and disposal
- RDT&E (system concept to full-scale prototype and commercial assessment)
- Radiation effects, detection, dosimeter standards and calibration
- Pier side and shipboard data collection and testing of waste technologies
- In-service engineering, life-cycle management and acquisition support
- Shipboard system evaluation, installation, start-up and certification
- System safety
- Environmental, Safety and Occupational health integration for ship acquisition

CODE 65 - STRUCTURES AND COMPOSITES DIVISION

Division Overview:

Structures & Composites Division develops and assesses advanced structural materials and designs (with a focus on composites) for combatant, non-combatant surface ships, submarines and other maritime applications. This full spectrum RDT&E provides concept development, modeling, materials and design analysis, testing/evaluation in lab/large scale/at-sea in addition to In-Service Engineering and Fleet support.

Capabilities and Expertise:

- Computational structural mechanics, design and analysis, and physical structural modeling
- Structural reliability databases and structural integrity risk analysis for affordable design
- Design procedure and criteria development
- Experience in structural loads and response (seaway, ice, air, and UNDEX)
- Hull and component strength (including propulsors)
- Ship and submarine structural concept development
- Large-scale structural laboratory testing and at-sea evaluations

CODE 66 - SURVIVABILITY AND WEAPONS EFFECTS

Division Overview:

Survivability and Weapons Effects Division develops vulnerability assessments of ships and submarines and provides the technology base (with a focus on testing: scaled-model, full scale and at-sea analysis) required to enhance survivability and recoverability.

Capabilities and Expertise:

- Ship/Submarine protection concepts against dynamic loading
- Design guidance for damage tolerant structures and system recoverability
- Underwater and Air Explosion (UNDEX/AIREX) testing, trials and analysis
- Shock trials, total ship survivability trials, surrogate ship tests, and full and scaled system/component tests
- Vulnerability and recoverability analyses and assessments
- Weapon’s loading and effectiveness assessments
- Hardening of hulls and equipment to UNDEX/AIREX threats
- Damage Control, Firefighting and Chem-Bio Defense equipment and IPE

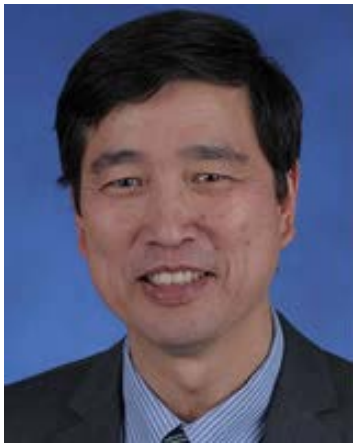
DEPARTMENT 70 - SHIP SIGNATURES

Department Overview:

The mission of the Ship Signatures Department is to assure that surface ships, submarines and other navy vehicles have signature characteristics, which will ensure their operational superiority over other navies. In support of the mission, the Department conducts research and development in the fields of underwater acoustics and non-acoustic signature control. Their staff supports the Fleet in establishing signature requirements. They oversee fundamental research and applied research in hydro-acoustics, structural acoustics, mechanical vibrations, target strength reduction, radar cross section (RCS) reduction, infrared reduction, electro-optical (EO) detection and advanced signal processing. As a result of this work, modifications are recommended for reducing the signatures of existing classes of ships and submarines, and guidance is provided on how to incorporate advanced signature control technologies into the design and construction of new vessels.

Department personnel conduct full-scale acoustics, vibrations, radar cross section, infrared and electro-optical measurements on ships and submarines. To accomplish the tasks, new techniques and data acquisition systems are developed for measuring the characteristics of signatures, including radiated noise, target strength, sonar self noise, RCS, infrared, and EO. From this work, operational and maintenance guidance are provided to the ships and type commanders.

Dr. Paul Shang
Ship Signatures (Code 70) Department Head



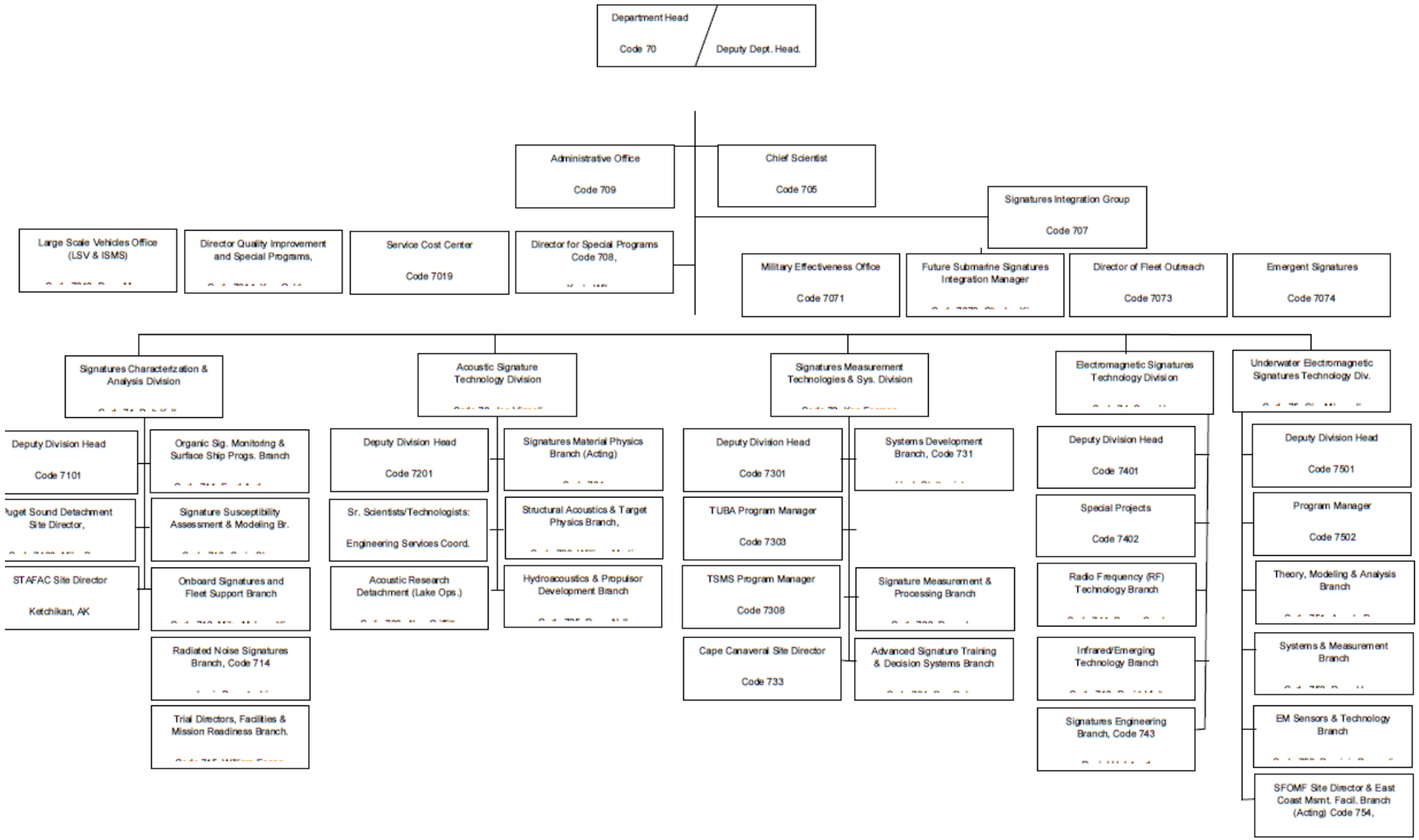
Dr. Paul Shang is the Director of the Ship Signatures Department for the Naval Surface Warfare Center Carderock Division. He is responsible for management of the complete spectrum capabilities of full-scale acoustics, vibrations, magnetic, electromagnetic, radar cross section, infrared and electro-optical measurements on ships, submarines and small craft for the U.S. Navy. As the director, he provides guidance on how to incorporate advanced signature control technologies into the design and construction of new vessels.

From October 2007 to February 2011, Shang was the head of the Signatures Integration Group, where he was responsible for the development and coordination of multi-spectral signature programs. From December 1999 to October 2007, Shang headed the Acoustic Signatures Technology Division, providing leadership and oversight of technology development and engineering applications for ship and submarine acoustic signatures. Since 1984, he has held numerous positions within the Carderock Division performing flow-noise and

structural acoustic analysis for the Seawolf Class submarine program. He also led Carderock Division's radiated noise and sonar self-noise research and design efforts for the Virginia Class submarine program.

Shang received his bachelor's degree and doctorate in mechanical engineering from Rutgers University in New Jersey.

Ship Signatures Department



CODE 71 - SIGNATURE CHARACTERIZATION AND ANALYSIS DIVISION

Division Overview:

The mission of the Signature Characterization and Analysis Division (NSWCCD Code 7100) is to fully characterize the acoustic signatures of Navy ships and submarines. This is accomplished by planning and providing the lead for the conduct of acoustic trials on ships, submarines and marine vehicle trials, and the subsequent analysis of the acoustic data acquired.

The division performs analyses of radiated noise, target strength, sonar self and structureborne noise to determine individual sources contributing to the overall signatures. It supports both research and development programs and operational programs by evaluating the effectiveness of research initiatives, ship alterations and Fleet signature maintenance efforts. They analyze the technical information that is pertinent to assessing the effectiveness of the research programs in mitigating ship's signatures. Based upon test results, the division recommends corrective actions in terms of required research programs, operational tactics, and, again, ship alterations and Fleet maintenance actions. This will lead to reduced vulnerability to detection and increased detection capability.

Division staff performs measurements and analyses of vibration and airborne noise of ships, submarines and marine vehicles, and evaluates the effectiveness and utility of signature control in support of requirement development. The signatures are associated with acoustic radiation and re-radiation, sonar self-noise and structureborne noise.

The division serves as the repository of the Navy's acoustic signatures databases. They are responsible for managing the facilities used to acquire full scale trial information and establishing requirements for new data acquisition and information processing systems included therein.

Capabilities and Expertise:

- Perpetuates the United States Navy's asymmetrical advantage in mobility and reach capability through innovation and maintenance of acoustic stealth.
- Supports Sea Power 21 with innovative approaches to fusing the measurement of operational effectiveness with acoustic objectives during at-sea testing.
- Empowers the warfighter to monitor real-time acoustic stealth, through training and distance support.
- Teams up with Department of Defense and civilian technology leaders to promote research and development efforts to advance the Navy's acoustic and target strength capacity.
- Coordinates with the Navy's intelligence community to maintain a technical database for present and future enemy acoustic capability and vulnerability.
- Provides strategic guidelines to Fleet operations.
- Identifies, prioritizes and provides early, preventative identification of maintenance actions.
- Provides measurements to verify ORD, TEMP, and shipbuilder performance objectives.

CODE 72 - ACOUSTIC SIGNATURES TECHNOLOGY DIVISION

Division Overview:

The Acoustic Signatures Technology Division's mission is to conduct research and development, and provide engineering services in structural acoustics, materials development, and hydroacoustics leading to effective and affordable control of ship acoustic signatures. They provide engineering analysis, prediction, and design for signature control techniques for acoustic target strength, hull radiation and associated transfer functions, flow-noise, and propulsor signatures. They determine and assesses the technical feasibility of acoustic signature requirements of marine vehicles. They develop, operate, maintain, and upgrade large scale-models to improve the Navy's ability to evaluate technological developments for the advancement of stealth technologies. The division provides expert engineering and technical services and experienced personnel necessary to support the Naval Sea Systems Command, and resource sponsors in acoustic silencing. They define the physical properties of materials and applications for the control of ship acoustic signatures and team and cooperate with other Department and Division organizations to perform its mission efficiently and at reduced cost.

Capabilities and Expertise:

- Provide expert knowledge and guide investigations of structural acoustics, hydroacoustics, and target strength for ship silencing.
- Directs the development of the required signature control materials, in cooperation with other branches, other departments, other divisions and industry.
- Develops a full range of application techniques, equipment, and installation technologies for signature control materials and conducts performance effectiveness tests of signature control materials.
- Evaluates design with full-scale installations on in-service naval ships.
- Develops performance requirements for signature control materials, which encompass the full range of acoustical and physical properties.
- Provides engineering analysis, prediction, and design for signature control techniques.
- Provides technical support for submarine and surface ship stealth programs.
- Conducts hydroacoustics/hydrodynamic measurements of both full-scale and model-scale propulsor hardware.
- Develops new facilities and capabilities; operates and maintains models, barges, boats, and facilities for operations at Lake Pend Oreille, ID.

CODE 73 - SIGNATURE MEASUREMENT TECHNOLOGIES AND

SYSTEMS DIVISION

Division Overview:

The Signature Measurement Technologies and Systems Division's mission is to design, develop, and support systems used for the measurement, acquisition, processing, and analysis of ship signature data. They design hardware and software to meet customer requirements for signature characterization, signal processing, signal imaging, and advanced algorithm development. They assesses the vulnerability of ship signatures for exploitation by threat sensors utilizing advanced, unconventional signal processing techniques and ensure commonality and interchangeability of data and systems.

The division designs, develops, and supports systems used by the operating Fleet support activities for the acquisition, processing and analysis of signature data. They develop interfaces between these systems and other ship systems and sensors and develop the techniques and processing for the collection, acquisition, processing, and analysis of signature data under deployed conditions by Fleet personnel.

Capabilities and Expertise:

- Designs, develops, and supports systems for the measurement, acquisition, processing, and analysis of ship signature data in support of full-scale and model-scale trials including systems for radiated noise, sonar self-noise, hullborne-noise, airborne-noise, and acoustic target strength.
- Designs, develops, and supports shaker systems for use in full-scale and model-scale trials and in support of fleet training and evaluation requirements.
- Designs, develops, and supports systems used by the operating Fleet and other Fleet activities for the acquisition, processing, and analysis of signatures data.
- Develops techniques, procedures and special sensors for the acquisition, monitoring, processing, and analysis of data by Fleet personnel under deployed conditions.
- Provides engineering and technical support to the Department, Systems Commands, Fleet Commands, and other activities in the application and exploitation of ship signature measurement technology, systems, sensors, visualization and devices.
- Operates, maintains, and manages data acquisition, processing and network facilities within the Department. Assures affordable data processing and provides life-cycle support for the Department's major data processing facilities, systems, and networks. This includes the budgeting and contract support for these systems.
- Operates, maintains, and upgrades Large Scale Vehicle (LSV) Guidance Navigation and Control Systems, radiated and on-board data acquisition and processing systems.
- Conducts research and development on high fidelity, range dependent, synthetic signature generation for acoustic, optical, infrared and other wavelength-based domains.
- Designs, develops, delivers and supports signature guidance systems that accurately estimate vulnerability at range as a function of signature, range-dependent sound speed profiles, and oceanographic conditions.

CODE 74 - ELECTROMAGNETIC SIGNATURES TECHNOLOGY DIVISION

Division Overview:

The Electromagnetic (EM) Signature Division's mission is to further cost-effective EM signature control on U.S. Navy ships, submarines, and craft. Their mission is accomplished by a full range of scientific, engineering, measurement, and Fleet-support services which include: Science and Technology; Research and Development; System Demonstration; Signature Prediction; Engineering, Application, and Acquisition Support; Measurement System Development; Full-Scale and Scale-Model Measurement; Measurement Analysis; Signature Data Basing and Information Technology Services; and Military Impact Analysis. The division supports the development of electromagnetic signature requirements by evaluating and assessing the utility of signature control and assessing the technical feasibility of their requirements.

Capabilities and Expertise:

- Researches the full range of radio frequency technology issues as they influence ship signatures.
- Maintains a radar cross-section (RCS) development plan that includes a road map for the development of future RCS measurement system
- Provides end-to-end prediction, measurement, and analysis services for electromagnetic signatures.
- Develops and maintains computer databases for all electromagnetic signatures.
- Researches the full range of infrared, optical, and electro-optical technology issues as they influence ship signatures.
- Explores, researches, and develops new, emerging electromagnetic signature technologies.
- Conducts a full-range measurement program for infrared and optical signatures.
- Applies signature control measures to ships, submarines, craft, and systems.
- Provides cross-signature program management and program support for signature efforts throughout the U. S. Navy and other government agencies.
- Conducts analyses that support RCS reduction engineering, application, and acquisition.
- Performs high level RCS modeling and simulation LO platform requirements analysis and design.

CODE 75 - UNDERWATER ELECTROMAGNETIC SIGNATURE TECHNOLOGY DIVISION

Division Overview:

The Underwater Electromagnetic (EM) Signature and Technology Division's mission is to provide full spectrum capabilities for research, development, design, testing, acquisition support, and in-service engineering for electromagnetic signature reduction and related technologies for all platforms. The division supports the NAVSEA Engineering and Technical Authority and the Technical Warrant Holders. The division develops EM signature requirements for NAVSEA 05T and OPNAV and evaluates concepts and systems for platform compliance.

The division is the Technical Development Authority (TDA) and In Service Engineering Agent (ISEA) for equipment, procedures, and technology for all Magnetic Silencing Facilities. They support the fleet with underwater measurements, on-board system calibrations, and signature

characterization of magnetic and electric signatures utilizing Magnetic Silencing Facilities, portable systems, and RDT&E measurement systems.

Capabilities and Expertise:

- Manages all underwater electromagnetic programs for the division and provides a review for all deliverables
- Provides theory, modeling and analysis capabilities for research, development, design, testing, acquisition support, and in-service engineering for electromagnetic technology and silencing and for fleet magnetic silencing facilities, AIMS deployable measurements systems, and Fleet units.
- Conducts assessments of the threats for all surface and undersea Navy platforms resulting from electromagnetic field emissions, including benefits of possible on-board systems countermeasures.
- Develops state-of-the-art sensors that are used to detect, localize and classify military targets as well as aid in the development of countermeasures.
- Performs physical model tests and measurements with NSWCCD's magnetic fields laboratory and electrolytic tank facilities. Designs, builds, tests, and evaluate EM sensors on-board platforms and at measurement sites.
- Supports the Navy with underwater EM measurements, on-board system calibrations, and signature characterization of magnetic and electric signatures utilizing Magnetic Silencing Facilities, portable systems, and RDT&E measurement systems.
- Operates and maintains the Magnetic Fields laboratory at Carderock Division (CD)
- Maintains acoustic and electromagnetic signature measurement capability in support of US Navy surface ships and submarines.
- Provides ocean engineering expertise and services for special, unique, and/or critical RDT&E projects for a wide variety of customers.

DEPARTMENT 90 – MACHINERY RESEARCH AND ENGINEERING

Department Overview:

The Carderock Division's Machinery Research and Engineering Department is responsible for overall technical and managerial direction for all machinery programs related to all ships, submarines and vehicle systems, encompassing full-spectrum technical capabilities (facilities and expertise) for research, development, design, shipboard and land-based test and evaluation, acquisition support, in-service engineering, fleet engineering, integrated logistics support and overall life-cycle engineering.

Patricia C. Woody
Machinery Research and Engineering (Code 90)
Department Head

After graduating in 1982 from the University of Pennsylvania with a B.S.E. in Mechanical Engineering, she began her career the Naval Ship Systems Engineering Station (NAVSSES) in Philadelphia. While at NAVSSES, she received her M.S.E. in Mechanical Engineering and Engineering Management from Drexel University.

From 1982 to 1986, Ms. Woody worked in steam propulsion and controls, responsible for the overhaul and upgrade of all control systems for the steam facilities enabling automated control of the entire plant, and traveling extensively on ships and aircraft carriers. She spent the following three years as a test engineer, associate test manager and Joint Test Group representative for the Improved Performance Machinery Program for the Main Propulsion Unit of the SSN 688I Class submarines.

Ms. Woody became the manager of Emerging Programs in 1991, responsible for development of new surface ship and submarine HM&E, T&E and new acquisition program development. In this role, she actively pursued involvement with LPD 17, CVX, AOEX, NSSN, USCG WAGB-2-, SC 21 and Arsenal Ship.

As head the Major Programs Branch from 1995 to 1998, she oversaw all test programs including the DDG-51 Land Based Engineering Site, Advanced Surface Machinery Programs (ASMP) which comprised Standard Monitoring and Control Systems (SMCS), Intercooled Recuperated (ICR) Gas Turbine Engine and Integrated Electric Drive (IED).

Promoted to Head of the Programs and Platforms Division in 1998 with responsibility for all major test programs and land-based engineering sites, acquisition and in-service platforms, alteration engineering programs, test operations and enabling technology, she had significant roles in the CG-47 Integrated Ship Controls program and was directly responsible for obtaining full-scale electric

propulsion testing for the DDG-1000 Integrated Power Systems in Philadelphia. She was assigned additional duties as the Deputy for Machinery Engineering, a position she held until 2005.

More recently, Ms. Woody guided a geographically diverse team of engineers and program managers from 2004-2006 in instituting a NAVSEA Warfare Center Product Area, Customer Advocate process within the 3300 person Carderock Division of the Naval Surface Warfare Center and the Ships and Ship Systems Product Area.

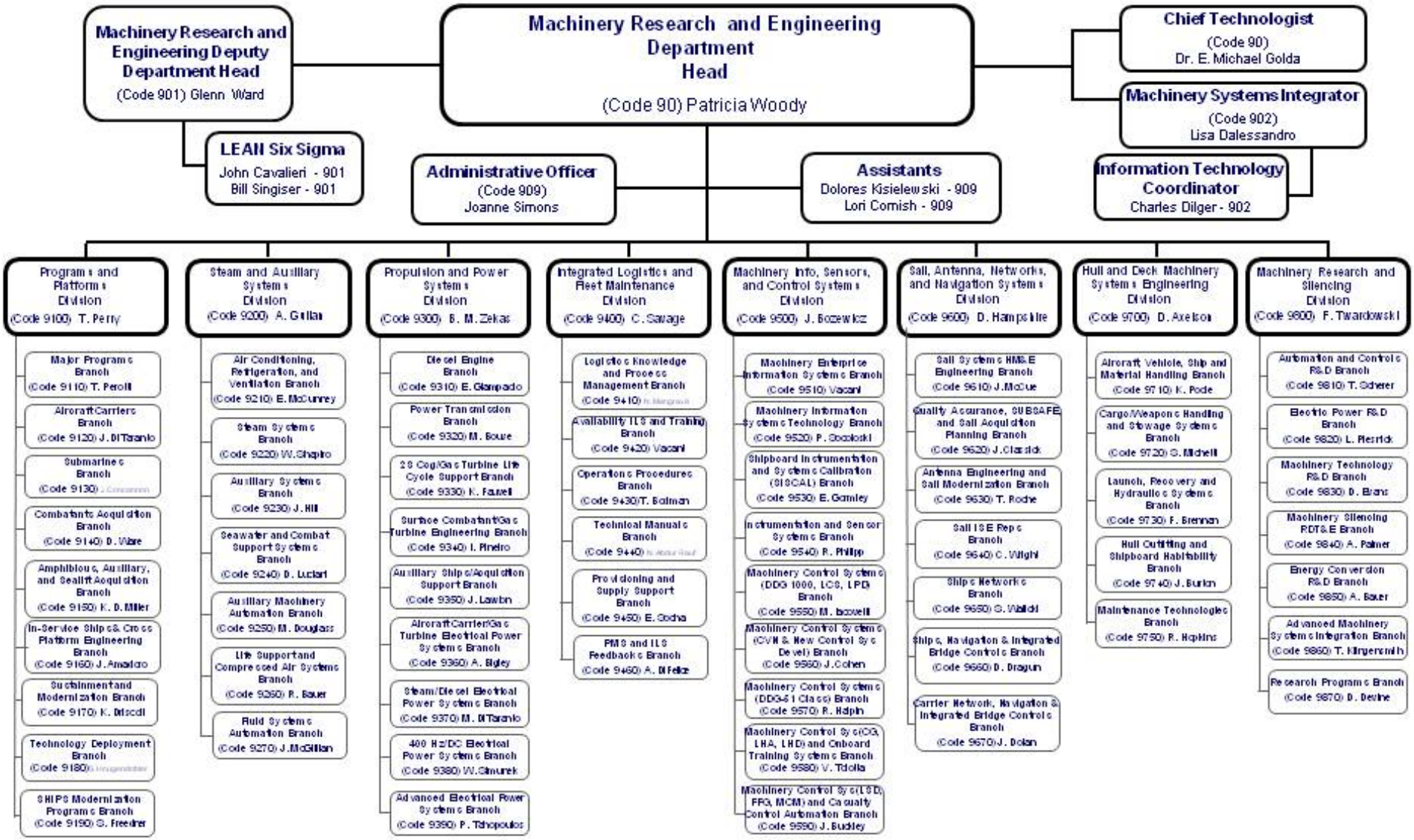
A scientific and engineering leader, in 2008 Ms. Woody became the first woman to achieve the level of Senior Scientific Technical Manager (SSTM), one of only 40 SSTMs in the Navy.

Ms. Woody was elected to serve as the Chairperson of the Penn State Dean's Advisory Board for the Office of Engineering Diversity Committee for Women in Engineering Program (WEP). In 2004, the program was honored with a Presidential Excellence Award for developing mentoring approaches that encourage improved achievement, keeping young people in the "pipeline" of science, engineering and mathematics education and creating peer mentoring programs. She also serves on the Villanova University College of Engineering Advisory Board. Her professional memberships include the Acquisition Professional Community, DAWIA Level III; the Navy League of the United States, ASNE, with which she served on the national council; IEEE, serving on its scholarship committee; and ASME IGTI, serving on the papers committee. Ms. Woody was appointed to serve as NDIA Philadelphia Chapter NAVSSES liaison and also serves on the technical conference committee of the Marine Systems and Technology (MAST) international maritime conference and exposition, and on the Ben Franklin Technology Partners of Southeastern Pennsylvania (BFTP/SEP) Review Committee.

The recipient of numerous awards, Ms. Woody has been honored with Philadelphia BusinessJournal's Women of Distinction Award (2011); Drexel University's College of Engineering Alumni Circle of Distinction Award (2008); the Drexel University Alumni Association "Special Distinction Award" (2008) in recognition of her professional and community involvement; the Department of Defense/Department of the Navy Women's History Month Award Recipient for Science, Technology, Engineering and Math (2006); the Women In Science and Technical Achievement Award (1990); and the Philadelphia Federal Executive Board Woman of the Year Award (1990).

NAVSEA WARFARE CENTERS Philadelphia

Machinery Research & Engineering Dept.



Updated January 2012

CODE 91 - PROGRAMS & PLATFORMS DIVISION

Division Overview:

We are responsible for:

- Managing all major machinery systems T&E programs, S&T / R&D programs and the Navy's Marine Gas Turbine (MGT) program.
- Management of platform customer support efforts with PEO SHIPS and the Fleet and PEO Carriers and Subs.
- Management of the MACHALT Program and coordinating Fleet Modernization efforts.
- Providing focus for emerging HM&E operational concepts, technologies, and processes.

Branch Functions:

- **911 - Major Programs**
  - R&D
  - DDG 51 LBES
  - IPS
  - Operation & Industrial Management
  - DS/Networks
  - Marine Gas Turbine (MGT)
  - ICAS
- **912 - Aircraft Carriers**
  - New Construction
  - In-Service Carriers
  - ICAN/DDCN
  - Smart Carrier
  - RCOH Program
  - Future Planning Acquisition
- **913 - Submarines**
  - In-Service Submarines
  - SSN 688; SSBN 726; SSN 21; SSN 23 Jimmy Carter
  - Sub Rescue Systems
  - Sub Research Vessels
  - SSGN Conversion
  - Undersea SOF Systems
  - ASDS and DDS
  - SSN 774 Virginia
  - SUBSAFE
  - Design & System Engineering
  - In-Service HM&E Tech Authority
  - TYCOM Reps
  - COMSUBFOR
  - COMSUBPAC
- **914 - Combatants Acquisition**
  - DDG 51
  - Building Yard Reps
  - DD(X)
  - LCS
  - CG(X)
- **915 - Amphibious, Auxiliary, and Sealift Acquisition**
  - LPD-17
  - SEALIFT Acquisition
  - JHSV
  - MPF(F)
  - LHD 8
  - LHA 6
  - LCAC
  - Sea Base to Shore Connector (SSC)
  - MSC In-Service
  - FMS - SEA63 In-Service and PMS 336 Ship Transfer
  - US Coast Guard In-Service and Deepwater Acquisition

- Technical Watch
- Program Analyst

- **916 - Ships Fleet Support**
  - DDG – 51
  - CG - 47
  - FFG - 7
  - LSD / LCC
  - LHA / LHD
  - LPD
  - MCM / PC
  - Tech Authority Critical Safety
  - Energy
  - In-Service Engr - Cross-Platform
  - CLASSRON
  - TYCOM
  - PMR
  - TMA/TMI
  - Fleet Reps
  - MSG Center
- **917 - Sustainment and Modernization**
  - Ships Avail Planning
  - SHIPMAIN & Alteration Policy
  - ECDIS-N / Scalable IBS
  - FFG-7 MOD
  - DDG-51 CL Alts
  - QMS / QA
  - HAZMINCEN
  - Army
  - Service Craft
  - Field Reps - CG ISC PMRs; CG Hull Mgrs; LSD ML Reps
- **918 - Technology Deployment**
  - Environmental Program Alts
  - Equipment Alts
  - Submarine Alts
  - Carrier Alts
  - ICAS Upgrades
  - Kitting and Staging Facility
- **919 - SHIPS Modernization Programs**
  - MOD Programs: CG – 47; DDG – 51; LSD – 41
  - Development

CODE 92 - STEAM & AUXILIARY SYSTEMS DIVISION

Division Overview:

We are the navy's principal provider of life cycle engineering and the engineering technical authority agent for steam propulsion and auxiliary machinery. We provide full spectrum engineering services supporting the development, design, acquisition, test, installation and maintenance of ships' systems. Through the pursuit of excellence in engineering, we strive to ensure the operational readiness and logistic support of forces afloat, reduce total ownership costs, and introduce improved and new capabilities and technologies for the defense and maritime industry.

Branch Functions:

- **921 - Air Conditioning, Refrigeration, and Ventilation**
  - Air Conditioning Systems
  - CFC Conversion
  - Refrigeration Systems
  - Ventilation Systems
  - All Related Ductwork
  - Thermal Management
  - Collective Protection System
- **922 - Steam Systems**
  - Steam Systems
  - Propulsion and Auxiliary Boilers and WHB's
  - Condensers
  - Main Propulsion Turbines
  - FDB/SSTG
  - CVN Secondary Steam/Cat Accumulators
  - HP Waterjet Support
  - BIRMIS Program Support
  - SGPI Program Management
  - FMS/MSC/MARAD Steam Support
  - Stationary Plant Boiler Inspection
  - Reboilers
- **923 - Auxiliary Systems**
  - Centrifugal Pumps
  - Positive Displacement Pumps
  - Assoc Pump Components
  - Auxiliary Turbines
  - Fuel Oil and Lube Oil Systems
  - Purifiers
  - Ballast/Deballast System
  - Related Piping, Valves, Comp & Actuators
  - Submarine Fluid Systems and Aux Machinery
  - SUBSAFE Design
  - Desalination Systems
  - Heat Exchangers
  - Main Feed/Cond/Booster Sys
  - Fresh Water Sys
  - Reverse Osmosis Technology
- **924 - Seawater and Combat Support Systems**
  - Sea Water Sys
  - Fire Main Sys
  - Biofouling Technology
  - VLS
  - Chilled Water Sys
  - Electronic Cooling Water Sys
  - Sonar Dome Pressurization Sys
  - SW/FM/ECWS Actuators
  - Smart Valves
  - Related Piping, Valve and Components
  - Bleed Air/Prairie Masker
  - Mounts/Piping System Acoustics
- **925 - Auxiliary Machinery Automation**
  - Main Boiler and Steam Plant Controls
  - CVN Secondary Steam Plant Controls
  - Catapult Steam Charging System Controls
  - FMS/MSC/MARAD Automation Support
  - Compressed Air /AC&R/ Ventilation System Controls
  - Submarine Life Support Controls
  - SSP Support
- **926 - Life Support and Compressed Air Systems**
  - Automated Electrolytic Oxygen Generator
  - Oxygen Generating Plant
  - LP Electrolyzer
  - Integrated LP Electrolyzer

- Central Atmosphere Monitoring Sys
- Gas Management Systems
- CO2 Scrubber
- CO-H2 Burners
- O2N2 Plants
- VSA Oxygen Producers
- Membrane Nitrogen Producers
- Compressed Air Systems
- Deballast Compressors
- HP Air Flasks

- **927 - Fluid Systems Automation**
  - Sea Water/Chilled Water/Fire Main /Electric Cooling Water Systems Controls
  - Sonar Dome Pressurization Sys Controls
  - Fuel Oil/Lube Oil System Controls
  - Ballast/Deballast Controls
  - SSP Support
  - Tank Level/Smart Valve Controls
  - Potable Water Sys Controls

CODE 93 - PROPULSION & POWER SYSTEMS DIVISION

Division Overview:

We are responsible for the overall management of shipboard propulsion machinery, power generating, and electrical distribution systems, and provide new acquisition/design, in-service engineering, land based testing, and life cycle management support to NAVSEA, the Fleet, waterfront support activities, other Government agencies, and Naval support contractors. The equipments and systems for which we are responsible include diesel and gas turbine engines, reduction gears, main propulsion shafting and bearings, propellers and propulsors, associated engine room auxiliaries, shipboard electric propulsion motors, electrical power generation systems, distribution and conversion systems, aviation electrical support systems, and shipboard lighting.

Branch Functions:

- **931 - Diesel Engines**
  - Main Propulsion
  - Ships Service
  - Emergency Generators
  - Engine Auxiliary Systems
  - Exhaust Emissions
  - DEI Program Management
- **932 - Power Transmissions**
  - Gears
  - Clutches
  - Shaft Brakes
  - Couplings
  - Main Shafting
  - Shaft Bearings
  - Propellers/Propulsors
  - Waterjets
- **933 - 2S Cog/Gas Turbine Life Cycle Support**
  - 2S Cog Mgmt
  - Depot Engineering
  - Configuration Mgt Autolog/Weblog
  - Mod Kit Mgmt
  - LBES

- Metrics

- **934 - Surface Combatants / Gas Turbine Engineering**
  - LM 2500
  - 501K17/34
  - KS-250
  - MT5S
  - LM500
  - LM6000
- **935 - Auxiliary Ships / Acquisition Support**
  - New Acquisition:
    - LHD/LHAR
    - LCS
    - DDG-1000
    - SSC
    - TF40B/ ETB40B
    - Solar
    - MT30
    - LM 2500+
    - LM1600
    - Intake/Exhausts
- **936 - Aircraft Carrier / Gas Turbine Electrical Power Systems**
  - CVN 60Hz Equipment
  - SSGT's/ EDG's
  - AEGIS Power Systems
  - GTG Controls/FADC
  - Line Voltage Regulators
  - SFMG's
  - 4160V Transformers
- **937 - Steam / Diesel Electrical Power Systems**
  - Turbine / Diesel Generators
  - Static Excitation Systems
  - Voltage Regulators
  - Governor Controls
  - New Acquisition (LPD-17, LHD-8)
  - SSN/SSBN Elect Power Systems
  - Midlife Upgrade
  - EPS Designs
- **938 - 400 Hz/DC Electrical Power Systems**
  - 400 Hz and DC MG Sets
  - MG Starters
  - Voltage and Freq. Monitors
  - Available Load Monitors
  - Static Frequency Converters
  - Current Limiting Devices
  - Degaussing Systems
  - Variable Speed Drives AESS/HESS
- **939 - Advanced Electrical Power Systems**
  - DDG SCM Support/FLT IIA
  - COTS Switchboards/CB's
  - 3000KW SSGTG
  - DD(X) New Acquisition Support
  - DD(X) LBES/EDM Testing
  - MFMIII
  - DDG Midlife Support
  - DDG PSA Support

CODE 94 - INTEGRATED LOGISTICS AND FLEET MAINTENANCE DIVISION

Division Overview:

We are responsible for providing the U. S. Navy integrated logistics data, products and training for Hull, Mechanical and Electrical (HM&E) systems which are delivered to the fleet in a fully automated and interactive environment. Additional responsibilities include providing administrative, organizational, and technical management to the largest technical data repository in the world.

Branch Functions:

- **941 - Logistics Knowledge and Process Management**
  - ILS Knowledge Management
  - Distance Support
  - Metrics
  - LPA
- **942 - Availability ILS & Training**
  - Availability ILS
  - Products & Certifications
  - Configuration Management
  - Training
  - **943 - Operations Procedures**
  - Steam Procedures
  - Diesel Procedures
  - Gas Turbine Procedures
- **944 - Technical Manuals** –
  - Surface Ship TMs
  - Submarine TMs
  - Carrier TMs
- **945 - Provisioning and Supply Support**
  - Surface Ship
  - Submarine
  - Carrier
  - Fleet Support
- **946 - PMS and ILS Feedbacks**
  - Surface Ship PMS
  - Submarine PMS
  - Carrier PMS
  - ILS Feedbacks Processing
  - Specifications & Standards Management

CODE 95 - MACHINERY INFO, SENSORS, AND CONTROL SYSTEMS DIVISION

Division Overview:

We are the principal providers of life cycle management and full spectrum engineering for Machinery Information, Sensors and Control Systems. We improve reliability and maintainability, reduce total ownership cost, and introduce enhanced and new capabilities/technology for the Defense and Maritime Industry. Our focus is on: (1)Condition assessment and monitoring techniques, technologies, and products. These include machinery parameter measurements, data acquisition systems and instrumentation, equipment condition databases and information systems, and automated screening, diagnostic and prognostic analysis tools; (2)Sensor systems and instrumentation engineering including shipboard instrumentation and system calibrations for all permanently installed shipboard sensor systems, instrumentation and test equipment; and (3)Design and development of shipboard Machinery Control and Monitoring Systems for propulsion and electric plants, auxiliary systems and damage control automation systems; Software development and maintenance for machinery control systems, onboard system trainers and other systems as required.

Branch Functions:

- **9501 - MCS Life Cycle Management**
  - Overall MCS Life Cycle Management
  - TWH Support
  - Software Certification and Safety
  - CMMI-based Standard Software-based-system Process
  - Software-based-system QA
  - Support SEA 05Z on NVR
  - MCS Commonality Initiatives
  - Obsolescence Management and ILS Processes
- **951 - Machinery Enterprise Information Systems**
  - LCM for Condition Assessment & Monitoring Sys
  - HM&E Intelligent Video Monitoring
  - Mission Readiness Systems
  - Maintenance Monitoring and Decision Support Systems
  - Automated Screening, Diagnostic and Prognostic System Development and Integration
- **952 - Machinery Information Systems Technology**
  - DAS Engineering: Hardware and Software
  - Development, Operation and Maintenance of TOAC Data Acquisition Sys
  - Specialized Data Measurements and Analysis Techniques
  - Automated Screening and Diagnostic Tool Development & Integration
  - Legacy Fleet Maintenance/Logistics Info Systems
- **953 - Shipboard Instrumentation and Systems Calibration**
  - Calibration of Installed Instrumentation, Machinery Cont Systems and Diagnostic Data Acquisition Sys

- CRL
- PMS (MRC) Calibration Procedures
- System Calibration Procedures (SCPs)

- **954 - Instrumentation and Sensor Systems**
  - TLIs
  - Wireless Sensors
  - Environ. Testing – Shock, Vibration, etc.
  - Thermal Imaging
  - JP-5 Console Certification
  - Electromagnetic Interference/ Compliance (EMI/EMC)
  - Flow, Temperature, and Pressure Sensors
  - Arc Fault
  - Salinity Indication Systems
- **955 - Machinery Control Sys (DDG-1000, LCS, LPD, MHC)**
  - Systems Engineering and Systems Integration
  - Software Development, Maintenance and Certification
  - CMMI-based Standard Software-based-system Process
  - LPD 17 SSA Lab
  - SETA MCS Lab Development
  - MHC 51 Class M/SCS SSA Lab
  - New Ship Design Support
  - **956 - Machinery Control Systems (CVN & New Control System Development**
  - All Phases of Carrier Control System Support
  - Machinery Control Sys Design and Development
  - Systems Engineering and Systems Integration
  - System Architecture Design
  - Software Design and Development
  - CMMI-Based Standard Software Based System Process
  - Hardware Design & Development
  - System Integration and Test
  - Software-Based Machinery Plant Trainers
  - Software/Hardware Maintenance and Certification
  - CVN Integration Lab
- **957 - Machinery Control Systems (DDG-51 Class)**
  - Propulsion Controls, Supervisory Electric Plant Controls & Data Logging for entire DDG Class
  - Systems Engineering and Systems Integration
  - Software Development, Maintenance and Certification
  - OEM Software/Hardware Testing
  - DDG 51 LBES Configurable to Flt I/II, Flt IIA MCS
  - DDG Modernization/Backfit
  - CMMI Based Standard Software Based System Process
- **958 - Machinery Control System (CG, LHA, LHD) and Onboard Training Systems**
  - CG 47 Integrated Ship Control – GTSLBES
  - LHD 8 Onsite Support
  - Systems Engineering and Systems Integration
  - Software Development, Maintenance and Certification
  - Acquisition Support
  - Software-Based Machinery Plant Trainers
  - Machinery Simulations
  - CMMI-based Standard Software Based System Process

- **959 - Machinery Control Systems (LSD, FFG, MCM) and Casualty Control Automation**
  - Damage Control Automation
  - Programmable Logic Controller Programming
  - Systems Engineering and Systems Integration
  - Software Development, Maintenance and Certification
  - Software-Based Machinery Plant Trainers
  - Machinery Simulations
  - CMMI-Based Standard Software Based System Process

CODE 96 - SAIL, ANTENNA, NETWORKS, AND NAVIGATION SYSTEMS DIVISION

Division Overview:

We are responsible for providing Life Cycle Management (LCM) and full spectrum engineering and logistics support for Submarine Sail and Antenna Systems and Surface Ship and Carrier Mission-Critical Networks, Ship Control, Steering and Integrated Bridge/Navigation Systems. LCM responsibilities include support for Ship Acquisition programs, Research and Development (R&D) initiatives, Hardware and Software Engineering, Machinery Integration, Test & Evaluation (T&E) and Integrated Logistics (ILS) as well as direct customer support efforts with the Fleet and Program Executive Offices for Ships, Submarines and Carriers. Engineering responsibilities include provision of Technical Warrant Holder ownership and support for Submarine Sail HM&E Systems as well as execution of Engineering Agent (delegated Technical Authority) functions assigned by NAVSEA 05Z and 05H Machinery Control and Networks Technical Warrant Holders.

Branch Functions:

- **961 - Sail Systems HM&E Engineering**
  - LCM, ISE for Periscope, EW, WLR-9, NAVID & NAVSAT HM&E Systems
  - LCM & ISE for Antenna, Towed System, Radar & Snorkel HM&E
  - SUBSAFE Engineering and Analysis
  - System Acoustic Improvements
  - SHIPALT & TEMPALT Design and Installation
  - SPECOPs Design & Installation
  - UMM Engineering & Testing
  - Submarine Sail Land Based Test Site
  - Virginia Class/SSGN NAVSEA Onsite Support
  - Field Change and Block Upgrade Development, T&E
  - **962 - Quality Assurance, SUBSAFE, and Sail Acquisition Planning**
  - SUBSAFE Certification
  - Level 1 Material Certification
  - Product Quality Assurance Program
  - Integrated Logistics Support
  - Technical Manual Development
  - Private Party SUBSAFE Qualification and Oversight

- MSD Onsite Support
- Tech Mgmt of Sail & Deployed Depot
- Mgmt for Technical Acquisition Programs
- Value Engineering Implementation for Sail & Deployed Systems
- SUBSAFE & Level I Material Handling and Storage

- **963 - Antenna Engineering and Sail Modernization**
  - Mast Antennas – OE-538 & OE592 MFM; AN/BRA-34 & OE-207 MFM; OE-562/HDR MMC; AN/BLQ-10 EW Outboard Sensor
  - RF Distribution & Controls Systems (RFDACS)
  - Deployed Antennas – BRR-6 & BRR-6B Buoy, AN/BRA-24 FWA
  - RTOF
  - Antenna/RF RDT&E Support
  - RF/Electronics Technical Services
  - Sail Modernization
  - Sail Maintenance and General Support
- **964 - Sail ISE Reps**
  - Submarine Fleet TYCOM Tech Reps
  - Tech Support of Squadrons, Maintenance Activities and Repair Facilities
  - Emergent Fleet Technical Assist
  - Shipyard Liaisons
  - Sail Zone and Install/FC Coordination Support
  - Sail Maintenance & Repair Evaluations, Test & Inspections
  - Sail System Training & Logistic Product Development Support
  - Fleet Reqts & System Performance Feedback (Sail and System)
  - SSIT
  - Failure and Config Data (Metrics and Monitoring)
  - Field Engr and Tech Support
  - System Design, Prog, & SUBSAFE Core Team
- **965 - Networks**
  - Mission Critical Network LCM/ISEA
  - Network Design/Specs/ABS-NVR
  - Network User System Integration
  - Network Mgmt and Monitoring
  - Network Security/Firewall
  - Network Systems Security Cert & Accreditation
  - Fiber Optic Cable Plant Verification
  - Fiber Optic Component Qualification
  - Fiber Optic Specs & Standards
  - LBTS Support:
    - LBES, CSEDS,
    - Wallops Island,
    - ICSTD, GLNTC,
    - LM-STS, MPIF
- **966 - Navigation Systems & Integration Bridge Controls**
  - Navigation Systems LCM/ISEA
  - Integrated Bridge Controls LCM/ISEA
  - Ship Control Systems
  - Ship Control Display Systems
  - Steering Control Systems
  - Integrated Bridge Systems
  - Scalable Integrated Bridge Systems
  - Nav Crit Distribution Systems
  - Navigation Display Systems
  - Electronic Charting Display Information System – Navy
  - Integrated Navigation and Radar System Simulation
  - Situational Awareness Bridge Display System

- **967 – Carrier Network, Navigation & Integrated Bridge Controls**
  - CVN Navigation Systems and Integrated Bridge Controls ISEA, SSA and Modernization
  - CVN Bridge/Navigation Displays and Nav Crit Distribution Systems
  - Control System (PLC) and HMI Development SupportCVN HM&E
  - Networks for Navigation, Critical Data and Ship/Machinery Controls
  - CVN Network Monitoring System, IA, PSSA
  - Norfolk Fleet and Modernization Support Office

CODE 97 - HULL AND DECK MACHINERY SYSTEMS ENGINEERING DIVISION

Division Overview:

We are the Navy's principal engineering agent for shipboard weapons and cargo handling systems, aircraft and land vehicle handling systems, launch and recovery systems, cranes, hydraulic systems, shipboard habitability and hull outfitting. We provide engineering services to support the development, design, acquisition, test, installation and maintenance of machinery systems for the Fleet, NAVSEA and the naval community to ensure the operational readiness and logistic support of forces afloat, reduce total ownership costs, introduce new capabilities and technologies to enhance readiness, and achieve mission requirements.

Branch Functions:

- **971 - Aircraft, Vehicle, Ship and Material Handling**
  - Aircraft Elevators/Doors
  - Vertical Package Conveyors
  - Amphibious Assault Systems
  - Powered Closures
  - Anchoring, Mooring and Towing
- **972 - Cargo/Weapons Handling and Stowage Systems**
  - Cargo, Weapons, Personnel & Medevac Elevators
  - 5" Ammunition Hoist System
  - Torpedo Hoists/Monorails Bridge Cranes /Misc Hoists, Lifts and Handling Systems /Dumbwaiters
  - Torpedo Strikedown Life System
  - Magazines
  - Ready Service Lockers
  - Universal Tie Down Systems
  - Aviation Ordnance Handling Systems
- **973 - Launch, Recovery and Hydraulics Systems**
  - Shipboard Cranes
  - Towed Body Handling and Stowage
  - Boat Handling and Stowage
  - Surface Ship Steering
  - Surface & Submarine Hydraulics
- **974 - Hull Outfitting and Shipboard Habitability**
  - Surface Ship and Submarine Hull Outfitting
  - Habitability

- **975 - Maintenance Technologies**
  - HM&E Systems Maintenance Engr.
  - MSC Material Handling Equipment

CODE 98 - MACHINERY RESEARCH AND SILENCING DIVISION

Division Overview:

We are responsible for S&T and R&D of shipboard machinery systems. The division technical thrust areas are aimed toward cost effective, rapid insertion of machinery system technologies for the present and the future Navy that meet stated or implicit requirements for: new or extended depth, range, speed and improved control; rapidly re-configurable systems; reduced manning through automation; reduced total life cycle cost; and greater life, reliability, and safety. The Machinery Research and Silencing Division is the only naval organization that has the development of naval machinery systems as its primary function. The major support of the department comes from the Naval Sea Systems Command (NAVSEA) and Office of Naval Research (ONR), however, other activities within DOD such as Advanced Research Projects Agency, etc., use the unique competencies of the division for new machinery developments.

Branch Functions:

- **981 - Automation and Controls R&D**
  - Machinery Systems Automation
  - Control Systems
  - Control Systems Software
  - Modeling and Simulation of Control Systems
  - Intelligent Agent Based Control Systems
  - Advanced Sensors
  - Survivable Wireless Controls Comms.
  - Autonomic Auxiliary Systems
  - Control Systems HMI
  - Smart Valve Technologies
- **982 - Electric Power R&D**
  - Generation
  - Distribution
  - Propulsion
  - Motors & Drives
  - Actuators
  - Conversion
  - Energy Storage
  - Power Electronics
  - Protection
  - Power Management
  - Machinery Analysis
  - Architecture Analysis
- **983 - Machinery Technology R&D**
  - CVN21 Class Mach. Sys Advanced Architectures
  - NNP System Advanced Develop. Program
  - S9G/ANPS Common Power Electronics and Controls
  - Medium Voltage Conversion/ Distribution Equipment
  - Electric Sys Modeling and Simulation
  - Energy Storage Equipment & Sys
  - Fluid System Silencing
  - Advanced Acoustic Measurement
  - Structural and Acoustic Modeling
  - Electric Motor Acoustic Modeling
  - Submarine Life Support Systems
  - Hydraulics/Actuators
  -

- **984 - Machinery Silencing RDT&E**
  - Machinery Silencing Design
  - Airborne and Structure borne Sys Silencing
  - Structural & Acoustic Modeling
  - Machinery Noise Isolation
  - Acoustic Data Acquisition
  - Acoustic Data Analysis
  - Machinery Vibration Acquisition and Analysis
  - Machinery Micro Balancing
  - New Ship Design Machinery Acoustic Assessments
- **985 - Energy Conversion R&D**
  - Fuel Cells
  - Reformer
  - Hydrodesulfurizers
  - Zinc Oxide Beds
  - Thermal Management
  - HVAC
  - Refrigerants
  - High Temperature Superconductivity
  - Cryogenic Cooling
  - Integrated Power Systems
  - Advanced Engines
  - Metal Fiber Brush
  - Modeling and Testing
  - Large Experimental UUV Systems
- **986 - Advanced Machinery Systems Integration**
  - Machinery Tradeoff Analysis
  - System Level M&S
  - System Optimization
  - Ship System Synthesis Models
  - Design of Experiments (DOE)
  - Total Ship System Thermal Modeling
  - 3-D Modeling – Virtual & Immersive Environments
  - Conduct Scale Model Experiments to Evaluate Machinery Concepts

987 - Research Programs